

THE EUROPEAN SAUSAGE INDUSTRY

by
John Schut*

I. HISTORY

Regular meat supply to man began with the domestication of the mammalian species sheep, cattle and pigs. The sheep was domesticated with the aid of dogs before a settled agriculture was established (7000 B.C.). By 3500-3000 B.C. several breeds of domestic sheep were known in Mesopotamia and Egypt. The domestication of cattle followed the establishment of settled agriculture about 5000-4000 B.C. Evidence is found that about 3000 B.C. cows were milked, and cattle fattened by forced feeding in Egypt at that time. It is assumed that the domestication of pigs is from a later date. However, in an area of Europe, now known as Hungary, pigs were domesticated by about 2500 B.C. In the Greco-Roman period the animal became of great importance, when hams were salted and smoked and sausages were manufactured. The word "sausage" is most likely a derivation of the Latin word "salsus," which means salted, and it has been suggested that the original types were prepared from cured meats and took the form of a "dry sausage." The ancient town of Salamis gives a place association for salami. Other types were known as Tomacina, Cirelli and Botuli, the latter providing an unfortunate link with food poisoning (Botulism).

Similar developments in the field of dry sausage took place in the southeastern part of Europe. It is interesting to note, that, even today, a considerable number of these types of sausages in southern and eastern Europe are still just cured and dried (not smoked). The process of fermentation — now one of the most essential steps in salami manufacture — was an unavoidable circumstance, inseparable from the only possible production method. In the middle European areas, these sausages could only be made during the winter season and it is understandable that other types of sausages developed here — sausage preserved by curing and heat treatment. Particularly an area, now indicated on the map as Germany and Austria, was the nursery of the cooked sausage.

Still more northward, i.e., roughly, in the Scandinavian countries, the main preservation method, besides salting, was cooling and freezing. And although drying was also known as a way of food preservation, this initially was used mainly for fish (e.g. stockfish).

As time passed on the areas shaded off into one

another, e.g. cooked sausage, became more and more known and popular in the northern and eastern countries. But it was not until the beginning of the 20th century that — due to the development of climate chambers — acceptable raw and dry sausage could be produced all over Europe and the whole year around.

A second period of spreading happened after World War II when, as a consequence of extensive business, but, above all, holiday traveling, the production of cooked sausage got under way in the south European countries.

However, the mechanism behind the distribution was a different one. In north and middle Europe raw and dry sausage production grew rapidly because the people liked them. In south European countries, the production of cooked sausage started because of the billions of north and middle European tourists, who asked for them. It took another two decades before the local population began to accept comminuted cooked sausage itself. This is only true for cooked meat sausage. The production of liver sausage in Spain is still limited and in Italy not worth mentioning.

II. CLASSIFICATION AND NOMENCLATURE OF SAUSAGE PRODUCTS

Ways to classify the various types of sausages are many. The one chosen for this survey is based on the grouping and terminology used in Germany. This country more than any other country has put its stamp on sausage manufacture for many centuries in Europe and outside.

In principle, this classification is based on the temperature treatment of either the final product or the raw materials.

In the tables I to IV, names and terms are given both in the German and English language.

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TABLE I

CLASSIFICATION OF SAUSAGE/COMMINUTED MEAT PRODUCTS ACCORDING TO HEAT TREATMENT BY THE PRODUCER

Group	HEAT TREATMENT OF	
	ingredients	final product
A Raw sausage Rohwurst	No	No
B I Cooked sausage Brühwurst	No	Yes
B II Cooked sausage Kochwurst	Yes	Yes
B III Jellied products Sülze	Yes	Yes
C Minced Meat Products "Hackfleisch"	No Yes	No Yes

From figure I, it can be deduced how many variations can be made on the subject sausage. In fact, most of the possible combinations are actually produced in bigger or smaller quantities. The majority of the cooked sausage consists merely of fine-meat emulsion (figure I, no. 1), but many combinations with either semi-coarse lean (2) or semi-coarse fat (3) and with both (6), as well as meat-emulsion blended with coarse-lean (4) or coarse-fat (5) and its combination (7) are known.

Among the salami types combinations of semi-coarse lean and fat (10) and coarse-lean and fat (13) are mostly seen.

Particularly in the field of Bratwurst all possible combinations are applied. The result is at least a couple of thousand different types. On top of this, many similar kinds of sausage have different names. So, the terminology of sausage is rather complex, although some kind of system can be found, based on association with localities, special occasions, sensory perception, etc., as is outlined in table V.

TABLE II

A NON HEAT TREATED SAUSAGES

A I RAW SAUSAGE ROHWURST

A I₁ non fermented fresh sausage
pork and beef —
Bratwurst
Thuringer (fein) —
Nurnberger (grob) —

A I₂ fermented —
Frischwurst
Mettwurst
Braunschweiger +
Thuringer +
Zervelat +
Theewurst +
Regensburger knack +
Thuringer knack +
Frankfurter +

A II DRY SAUSAGE DAUERWURST

Salami types
Salami
Italian + —
Hungarian + —
Zervelat +
Plockwurst +

+ = smoked
— = not smoked

TECHNOLOGY

The technological aspects of the sausage manufacturing can be divided in the following items, viz:

- a. Manufacturing equipment and processes.
- b. Formulations and raw materials.
- c. Binders and additives.

A RAW AND DRY SAUSAGES/ROH UND DAUERWURST

- a. Equipment and processes.

The main equipment for raw and dry sausage production is the mincer and/or bowl chopper, (vacuum) mixer, stuffer, climate chamber and in a number of cases the smokehouse. In bigger operations the vacuum chopper is gaining popularity. In Italy and in some parts of eastern Europe the mincer is the exclusive machine for comminution. In most other countries and, particularly, for those factories using deboned frozen meat the bowl chopper is applied. In some cases part of the lean meat is minced and blended with the balance of the chopped meat and the fat, either at low speed in the bowl chopper, or,

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TABLE III

B HEAT TREATED		COOKED SAUSAGE 1		BRUHWURST	
B I Heat treatment of final product					
B I ₁ non fermented					
	Small goods			Wurstchen	
cured	Frankfurters	+		Frankfurters	+
	Vienna's	+		Wieners	+
	Hot Dogs	+		Knacker	+
				Bockwurst	+
	For slicing			Aufschnitt	
	Polony	—		Lyoner	+
	Lyoner	+		Jagdwurst	+
	Pork luncheon meat	+ —		Fruhstuckfleisch	—
				Schinkenwurst	+
				Bierwurst	+
	Loafs			Formproducte	
	Veal and pork	—		Leberkase (Bavarian)	
	Veal and egg	—		Fleischkase	
	Luncheon	—			
B I ₂ non fermented					
				Bruhbratwurst	—
uncured				ungerotet	
				Gelbwurst	—
				Munchener	
				Weisswurst	—
B I ₃ fermented					
	Mortadella	+		Mortadella	+
cured	Cooked salami	+		Koch Salami	+

+ = smoked
— = not smoked

in a vacuum mixer to achieve a better binding and coherence.

A trend has started to stuff the sausage mix at a lower temperature than formerly practised. Especially, the fast continuous stuffers demand a low temperature (-4°C; 25°F) to prevent smearing. The use of frozen fat to achieve a low sausage mix temperature is an unfortunate custom, since mincing and chopping of frozen fat give rise to a considerable damage of the cell walls of the fat tissue. This results often in dripping of fat from the final sausage, particularly in warm countries. In some factories the ready stuffed sausages hung over night in a cool place (+5 to 8°C; 40 to 50°F) before they are transferred to the fermentation chamber to avoid a too quick change in temperature. Stuffing is done in natural as well as in artificial and collagen casings.

Raw sausages like "Mettwurst" and "Teewurst" are fermented in airy rooms for the formation of a stable colour and then smoked to the desired colour and

taste. Although exceptions are found, one can generally say that coarse products like some types of Mettwurst are cold smoked, whereas very fine and spreadable sausage like Teewurst get warm smoke.

For dry sausage production, basically, the same machinery and processes are used. In big scale productions mincing, blending and stuffing are performed continuously. After blending, the sausage mix is automatically transferred by a plunger into stainless steel cylinders which are transported by rail and automatically fitted to the stuffers. The further processes are done either according to the natural or the rapid method.

In the former, fermentation, drying and smoking, if any, are done at temperatures between 12° and 15°C (53 to 59°F) during times ranging from some weeks to several months. In the latter case, fermentation is performed at temperatures between 20° and 25°C (68 to 77°F) and relative humidity (R.H.) of 92-95%. The subsequent smoking and drying are done at temperatures preferentially below 20°C (68°F) and gradually decreasing R.H. down to about 78%. This method takes from 5 days to 3 weeks. Limited amounts of glucono delta lactone (G.D.L.) are used, but its use is not widely spread. Starter cultures are more frequently used, particularly when frozen im-

TABLE IV

B II Heat treatment of raw materials		COOKED SAUSAGE 2		KOCHWURST	
B II ₁					
	Liver sausage			Leberwurst	
	Braunschweiger-			Braunschweiger-	—
	Thuringer-			Thuringer-	+ —
	Country style-			Hausmacher-	+
				Land-	—
				Berliner-	—
B II ₂					
	Blood sausage			Blutwurst/Rotwurst	
	Black pudding			Thuringer	+ —
				Nort deutsche-	—
				Sud deutsche-	—
				Hessische	—
				Leberblutwurst	—
	Tongue sausage			Zungenwurst	+
	Kidney sausage			Nierenwurst	+
B II ₃					
	Jellied products			Sulze	
				Hausmacher-	—
				Kopf-	—
				Press kopf	+
				Schwartenmagen	+

+ = smoked
— = not smoked

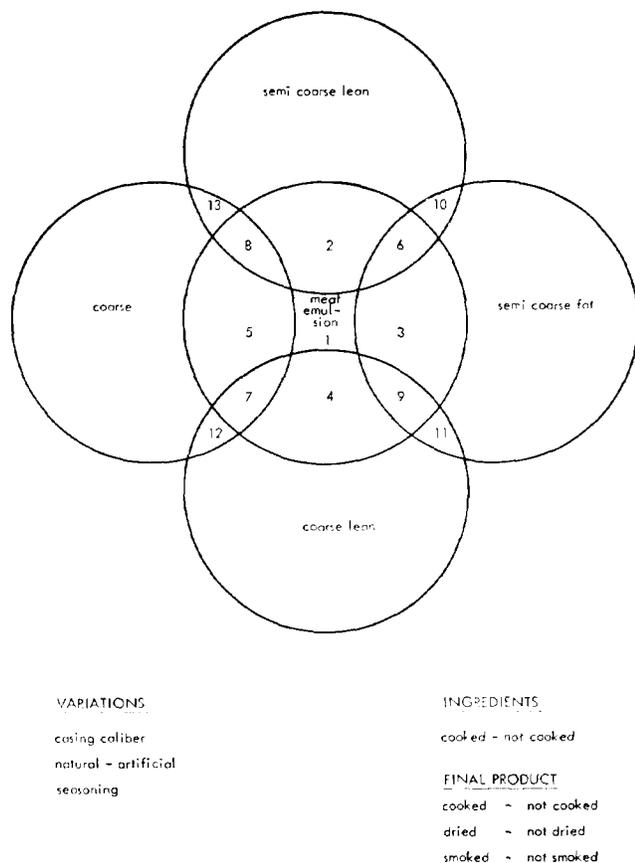


FIGURE 1

TABLE V
 TERMINOLOGY OF SAUSAGES

Names associated with

a. **Localities:**

Frankfurters (D), Vienna's (A), Braunschweiger (D), Berliner (D), Hungarian salami (H), Polony (Saucisse de Bologna) (F), etc.

b. **Meals**

Luncheon meat (U.K.), Breakfast sausage (U.K.), Frühstückfleisch (D), Ontbijtworst (NL), Lunch (E).

c. **Special occasions**

Lanantai (F = saturday sausage), Saunalekki, Bierwurst (D), Bierschinken (D).

d. **The main ingredient**

Pork-, beef-, veal sausage (U.K.), Kjøttpolser (N = meat sausage), Kodpolser (DM), Schinkenwurst (D), Hespensworst (B), Hamwurst (NL).

e. **Sensory perception**

1. **Taste:** Garlic sausage (U.K.), Pepperoni (I), Saucisse-Ail (garlic) (F), Zwiebelwurst (onion) (D).
2. **Colour:** Red: Rotwurst (D), yellow: Gelbwurst (D), white: Weisswurst (D), Boudin blanc (F), black: Black pudding (U.K.), Boudin noir (F).
3. **Auditive:** Knacker, Knackwurst (D).
4. **Visual appearance:** Bockwurst (Bock = hegoat) (D), Hot dog.

ported meat is used. Especially with the quick production method, a slippery layer on the casing, due to mold and bacteria growth may give some trouble. A light smoke during the last stage of fermentation, combined with subsequent dipping in a potassium sorbate solution can overcome this problem to quite an extent. For those types produced with a mold layer on the casing, controlled inoculation is in some cases replacing inoculation by change.

Fresh sausages such as pork and beef sausages are also raw items, although not fermented. As far as Europe is concerned, the production is limited to the United Kingdom. They are made in the bowl chopper, at temperatures not exceeding 5°C (40°F), stuffed into narrow-medium hog casing, mostly in either six or eight to the pound. The sausages are wrapped in plastic foil, stored in the refrigerator, distributed under cooling and fried by the customer. Some types of fresh sausage are artificially coloured, by using pink rusk. Also Bratwurst, which is quite popular in Austria, Switzerland, Germany and the Scandinavian countries (known as Medister) is originally a fresh sausage. At present, however, most of the Bratwurst is cooked by the manufacturer. Therefore this kind of product will be discussed under "Cooked Sausage."

b. *Formulations and raw materials.*

The raw materials normally used are either lean pork or beef or a combination and hard pork fat, mostly pork-back fat. The use of mutton is rare. In Sandinavian countries excellent dry sausages are produced from reindeer meat.

For cheaper types of dry sausage varieties like hearts, rinds and in some cases rind emulsions are used.

Recipe formulations range between lean : fat = 70 : 30 and 50 : 50 although exceptions can be found.

For fresh sausage the main ingredients are either pork or beef meat and pork fat, and a relatively high percentage of cereals. Also rinds are used.

c. *Binders and additives*.*

In a number of countries binders are permitted and used, such as skimmed milkpowder, soy isolate and concentrate, milk proteins (caseinate) and dextrans. Normal additives are salt, nitrate, nitrite, polyphosphates*, ascorbic acid (ascorbate, iso-ascorbate*) mono and diglycerides of fatty acids derived from animal fat**, dextrose, maltto dextrans, saccharose (sucrose) and more recently the use of lactose gets

*depending on legislation in various countries
 **Western Germany

more and more popular. G.D.L. and starter cultures have been mentioned already. In some special types of salami wine is used.

Spices: pepper, paprika, mace, garlic, cardamom, clove, rum.

For fresh sausage formerly soaked bread, cooked rice and potatoes have been used; at present rusk and some starch are more frequently applied. Amounts up to 10% or higher are no exception.

B I COOKED SAUSAGE I./BRUHWURST

a. *Equipment and processes.*

The mincer and/or bowl chopper, (vacuum) mixer, blender, mill and stuffer are the machines most frequently used. Small productions are manufactured in batches, while bigger operations are performed more and more semi-continuously. Any imaginable combination may be found. However, (mincer)-bowl chopper - pump - (bucket) - mill - stuffer and mincer - mixer/blender - mill - stuffer are the best known. The so-called pre-blending system gains more and more popularity in Europe. Started as a means to obtain uniform raw material, the combination mincer - pre-blender - mill - stuffer provides in many factories a more or less continuous production system. The system is rather new in Europe and no great agreement as to optimal conditions, such as blending time, temperature, order of addition of the raw materials, binders and additives has been reached. For critical products the conventional chopper/mixer/stuffer process is preferred in most cases. Combination machines, consisting of pre-cutting device, (vacuum) mixer and mill can be found in several forms. Pump extruders, piston stuffers, continuous stuffers supplying either linkers, twist linkers, portioners or clipping units as well as peelers supplement the equipment normally in use. Smoke houses vary from those with natural draught up to the most modern equipment. Cooking is done either in a water bath or in steam cabinets or chambers and ovens are used for baking.

Sterilization is mostly by batches although continuous retorting also is done. Rotation retorting is rare.

All known types of casings are used, especially, in central Europe relatively great amounts of small sausages are produced in natural casings (sheep casings). Also the production of skinless is considerable. A rather new development is a type of skinless sausage for which no casing is used. The sausage mix is extruded directly into hot water. After a short time when the periphery of the sausage gets coagulated, the product is removed from the water and frozen.

The consumer fries the sausage in deep fat.

Also, as far as packaging is concerned, the existing types and techniques in Europe show a great similarity to those used in the U.S.A. All types of packaging materials, such as steel and aluminum cans, glass jars, ceramic pots, aluminum and plastic containers, pouches, shrink foils, wrapping materials for vacuum packaging are applied. The same holds for packaging machinery.

b. *Formulations and raw materials.*

The raw materials mostly used are pork and beef meat. The use of mutton is limited and the same holds for horse and poultry, i.e., partly for legal reasons, partly on other considerations. Varieties, such as hearts and diaphragm, offals, such as tripe, pork skin, stomachs, etc., are basically allowed in most countries, although not used in every product. In some countries, e.g. Western Germany, sausage products are divided in two or three quality categories. For each of them the raw materials which can be used are defined. Mechanically, deboned meat is used in an increasing number of countries. In some countries the amounts are limited by law, in other countries by technological or sensoric considerations.

As far as the fat tissue is concerned restriction is little, i.e. almost all fat derived from common mammalia may be used (exception e.g. beef tallow in Western Germany). The use of all adipose fat in any form is allowed, viz. as whole cuts e.g. pork belly, as fat trimmings, in the form of pure fatty tissue, such as pork suet, beef fat, as rendered fat, etc. Every skilled sausage maker knows that the successful production of cooked sausage depends among other things on the type of fat used. Firm adipose tissue such as pork back fat, belly fat, jowl and ham fat are preferred, although for different applications. The soft fat of the ventral part of the belly is less famous, whereas beef tallow, beef fat and pork suet can not be used without a special pre-treatment, on penalty of failures, i.e., fat separation, greasy taste and grainy mouthfeel. The European sausage manufacturers use all kinds of fat in any cooked sausage, strikingly different from what the American meat industry does. The former is able to produce stable cooked sausage of good quality with any type of animal fat by pre-emulsifying the fat in water by means of a non-meat protein. This development became known and popular about 20 years ago and is still enjoying popularity. The non-meat protein used for this purpose originally was and still is milk protein (sodium caseinate). Some sophisticated types of soy protein make satisfactory emulsions, although its lower salt toler-

ance may be a limiting factor in practice.

In many factories all kinds of fat trimmings and other fatty tissue are emulsified. The fresh or chilled fat is shortly chopped, the caseinate is added, followed by the addition of boiling water. After 4 to 6 minutes chopping 1.5 to 2% salt is added. After another minute chopping, the emulsion is taken out of the chopper and chilled. After chilling the emulsion can be incorporated in almost any type of cooked sausage. For optimal emulsion stability chopping time (depending on the type of chopper) and emulsion temperature are of great importance, as can be seen from figures 2 and 3. Recommended temperatures during emulsion production are: pork fat emulsion $>45^{\circ}\text{C}$ (113°F) and for beef fat emulsions $>50^{\circ}\text{C}$ (122°F). For some purposes emulsification can be performed with the use of cold water or the hot emulsion — made with a part of the hot water — may be shock-cooled afterwards with the balance of ice. This method frequently used for cooked meat sausage and loaves, enables direct incorporation of the emulsion into the sausage mix.

The emulsion proportion mostly practiced is caseinate : fat : water = 1 : 5 : 5 or for a special type of high viscous caseinate : 1 : 8 : 8. With the latter type of caseinate, also, other proportions are possible. About 1/4 or 1/3 of the total fat in the formula can be used in the pre-emulsified form. Besides the possibility to use any type of fat this method has demonstrated to provide a better fat and water binding, a greater heat stability of the sausage, a guaranteed absence of any greasy taste and a production process, which is considerably less sensitive with respect to chopping time and emulsion temperature.

Formulations of cooked sausage may vary from

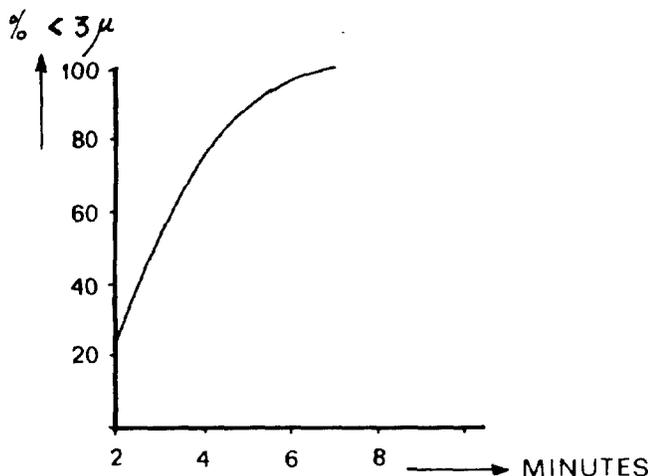


FIGURE 2
CASEINATE: FAT : WATER = 1 : 5 : 5 EMULSIONS

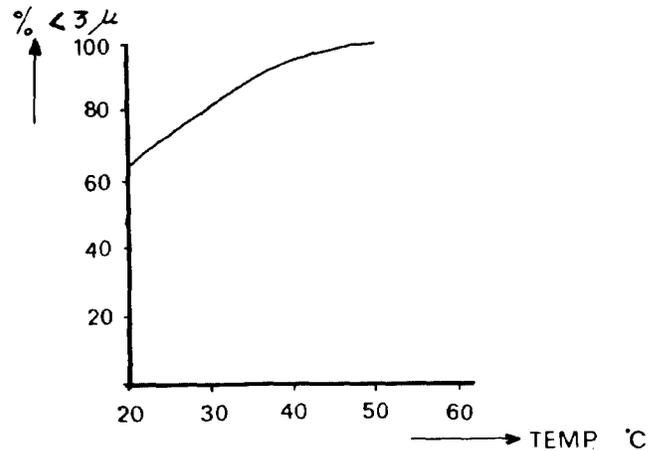


FIGURE 3
FAT PARTICLE DIAMETER IN RELATION TO CHOPPING TIME (UPPER CURVE) AND CHOPPING TEMPERATURE (LOWER CURVE)

pure lean meat ($>50\%$), ice, fat, curing salts and spices to sausage consisting of as low as 20% meat (head meat, hearts etc.) considerable amounts of rinds, water, fat, additives and binders. Fat contents range from $<18\%$ to over 35%. Collagen rich materials vary from none (sometimes tendons are removed from the meat) to high amounts of rinds ($>15\%$). Binders and additives which promote fat and water binding, such as polyphosphates, range from very low (only 0.3% polyphosphate or 2% sodium caseinate) to almost unlimited use of all possible binders and in addition up to 0.5% polyphosphate. The legal regulations have a great influence on the formulation of the sausage. Where the authorities are generous with respect to added water but forbid most of the binders and/or polyphosphate, sausage making still is an art and recipe variations are limited. Also, when the use of connective tissue is restricted or even forbidden, the sausage products are of excellent quality but also expensive.

On the contrary, where added water is forbidden, the possibilities to produce a good quality sausage is rather small and the manufacture of lower-priced sausage forces to extensive use of collagen-rich material, often combined with a high fat content. In countries where added water is not regulated and binders are allowed, lean meat content is generally low, whereas binders and water content are high; fat may vary from low ($<18\%$) to high ($>35\%$).

c. Binders and additives.

Most of the binders used are starches and flours (potato, corn, wheat), milk proteins (sodium caseinate), skimmed milk powder, soy products (isolate and concentrate), wheat gluten, egg white, and blood

plasma, either frozen or dried. The use of textured proteins in sausage is limited.

The additives used comprise: water, salt, phosphates, citrates, ascorbic acid, nitrate, nitrite, mono sodium glutamate, G.D.L., dextrose, malto dextrine, lactose, smoke concentrates.

Spices: pepper, nutmeg, coriander, ginger, mace, cardamom, paprika, garlic.

B II and III COOKED SAUSAGE 2./KOCHWURST

a. *Manufacturing equipment and processes.*

The equipment used comprises: cooker, mincer, chopper (vacuum, cooking), mill and stuffer.

On the European continent most of the liver- and blood sausage is made of pre-cooked fat, meat, rinds, tripe, stomachs, etc. The liver is not pre-cooked. On the contrary, in the U.K. the use of pre-cooked ingredients is not common practice, although not unknown.

On the continent the liver is chopped with a part of the salt and the curing ingredients. When, after some chopping bubbles begin to form, the pre-cooked fat and broth, if any, is introduced. Chopping is continued till the desired fineness is almost achieved. Then the balance of the salt and spices is added. This fine sausage mix, showing a temperature between 35°C (95°F) and 50°C (122°F) may be either stuffed to give a fine liver sausage, or be used as a base for a series of other liver sausage. By chopping in pre-cooked meat, or mixing in pieces of cooked meat, fat and/or liver, many different types of liver sausage are made.

For liver sausage containing a certain amount of broth a much easier technique is in use now. The water in which the fat and the other ingredients are pre-cooked is used as the broth. Both broth and fat are brought in the bowl chopper, where the fat is emulsified by means of sodium caseinate. The pre-chopped liver is then added to the emulsion and after a short chopping the sausage mix is ready. The liver may also be minced and added to the emulsion. Finally the mixture is passed through a mill. This method goes easily and fast and allows much more recipe variation than the conventional process. Particularly, for high temperature baking or canning, more stable products are obtained and also, for the incorporation of fresh fat, this technique can be used (U.K.).

Sausages are stuffed either in natural or artificial casings. For some types of liver sausage a fat lining—mostly applied in artificial casings—is used. Also fat-lined moulds are used.

As far as blood sausage is concerned, here, also, fat, meat and rinds are pre-cooked. The blood is cured with salt, nitrite and either citrate or phosphate to prevent clotting. If the blood is pre-cured and aerated for some time the resulting sausage has a pinky colour. Otherwise, the sausage becomes black at cooking. The pre-treated blood is warmed up and chopped with the rinds, and in some types with pre-cooked meat. Also diced material may be added e.g. cubed fat. During cooking and cooling sausages are occasionally turned to achieve an even distribution of the cubes. Big caliber casings, hog stomachs and moulds are mostly used.

Jellied products are all made on the basis of a gelatin jelly, for which either pure gelatin or cooked rinds are used. In the latter case the cooked rinds are finely ground after long cooking at about 80°C (176°F). After cooking the well-done rinds are passed through the fine disc of the mincer and may afterwards be sifted as well. The firmity of the jelly can be regulated with gelatin.

For a good taste some vinegar or white wine may be added. The meat and the fat ingredients are well cooked. The meat has to be pre-cured if a pink colour is wanted. The cubes of meat and fat are then mixed with the rind jelly and seasoning. The product can now be stuffed into casings or hog stomachs and be cooked and cooled. According to another technique, the product is cooked once more and filled into clean moulds and chilled.

b. *Formulations and raw materials.*

For liver sausage a great number of recipe variations is known. Sausage may consist of a fifty-fifty liver to fat ratio plus seasoning, down to as low as 15% liver with 30% broth, 35% fat, some cooked rinds and binders. The product ranges from well-spreadable to sliceable, mainly depending on the amounts and proportions of meat, collagen and binders.

On top of this many variations are created by adding coarse meat, liver and fat pieces to the fine sausage emulsion.

The degree of fineness of the meat and fat ingredients, particularly, the seasoning, determines the type of liver sausage.

The main ingredient for blood sausage obviously is blood. Besides blood cooked rinds are essential, and for the various typical kinds of blood sausage cubed fat, tongue, kidney and pork belly are used. For cheaper types also varieties such as tripe, lungs and stomachs may be found.

For jellied products the principle raw materials are rinds, gelatin, lean meat trimmings, pigs hind foot, calves foot, defatted head meat, firm fat tissue (e.g. back fat) and in some cases hearts.

c. *Binders and additives.*

For liver sausage the following binders are used: sodium caseinate, skimmed milk powder (only for pasteurized items), cereals — mainly wheat flour — and some potato starch. In some cases egg white or whole egg are applied. Blood plasma is not widely used in liver sausage.

As far as the additives are concerned, apart from C.D.L. the same items are used as mentioned for cooked meat sausage. Particularly lactose is a popular product in order to give a mild taste to the final sausage.

Spices: pepper, nutmeg, marjoram, mace, pimento, clove, ginger, cardamom, cinnamon, onions, shallots, truffles, pistachios.

In blood sausage mainly cereal binders such as barley and rye flour are used.

As additives are used: polyphosphates, citrates, nitrite and salt for preparing the blood and curing the meat ingredients.

Spices: pepper, marjoram, cloves, pimento, thyme, cinnamon, ginger, onions and in some special types: coriander.

In jellied products no ordinary binders can be used on penalty of a turbid jelly. Gelatin is frequently used.

As additives the normal items for meat curing are applied.

Spices: pepper, pimento, marjoram, ginger, clove, kummel, celery, bay leaf. On top of this, vinegar and white wine may be used.

BRATWURST

As mentioned under raw sausage, the majority of the Bratwurst, in fact, is a cooked meat sausage, at present. The way of production and the formulation used are within the framework of the cooked sausage as well.

Originally recipes consist of 60-70% lean pork meat and 40-30% firm fat tissue (back fat) and two main types were produced, viz. coarse and fine Bratwurst. They were stuffed in narrow hog casings and frequently rubbed with milk or egg, and milk was sometimes incorporated into the sausage mix. At the present time skimmed milk or skimmed milk powder are used in some formulations, but, apart from the narrow hog casing, the "habitus" of the original Bratwurst is often gone. The greatest resemblance to the original

Bratwurst is a kind of minced meat in a hog casing, which is sold in some parts of Europe.

C MINCED MEAT PRODUCTS

Although strictly speaking, minced meat products, such as hamburgers and meat balls, are no sausage, the formulations have developed in such a way that they — in many cases — only differ in shape from cooked sausage but not always that.

a. *Equipment and processes.*

The main equipment consists of: mincer, mixer, forming machine/patty machine, fryer, freezing tunnel.

Hamburgers and meat balls may be sold fresh, either under refrigeration or in deep frozen form. However, an increasing quantity of these items are fried in the factory and sold as ready food.

b. *Formulations and raw materials.*

Where hamburgers and meat balls are sold fresh they mainly consist of minced meat from pork, beef or a combination of the two. In many cases, however, i.e., when the products are heat treated in the factory, the majority consists of mixtures of minced meat and fine meat emulsion and/or binders. The proportion minced meat to meat emulsion may vary from 90 : 10 to 20 : 80, according to quality and price. Sometimes pre-cooked meat (e.g. head meat) is incorporated to avoid excessive shrinkage during frying. The industrially cooked items are sold either in plastic containers under refrigeration or in deep frozen form, or canned (with gravy) or as a "dry pack" (canned without gravy). In some cases the mix is stuffed into big caliber casing and cooked.

This "hamburger sausage" is sliced in half an inch slices by the retailer or the consumer.

c. *Binders and additives.*

Almost all imaginable binders, basically all materials a housewife may add, are found in minced meat products, and range from cereal flours and starches, boiled cereals and potatoes, rusk, soy proteins, structured soy flours and concentrate, and skimmed milk powders to sodium caseinate (in the emulsion part). As additives the normal accepted curing salts are used.

Spices: pepper, nutmeg, ginger, etc.

N.B. A striking exception is Western Germany where minced meat products are covered by the "Hackfleischverordnung" (Minced Meat Regulation), which means that nothing can be added, not even salt and spices.