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Technology and Control in the Production of Dry Sausages

There is a wide variety of dry sausages produced in Europe which differ very much due to raw material composition (proportion of fat to lean), methods of cutting and the flavouring with spices and by smoking. But even so, it may be possible and worth-while to try to standardize and control the production of certain types of dry sausages.

The aim of a sausage manufacturer must be to produce sausages of a specified quality concerning appearance, organoleptic, and keeping characteristics and to maintain a uniform product and to avoid fault productions.

In order to bring a dry sausages production under control it is necessary to take a close look at the different steps in the procedure.

Selection of Raw Materials

The selection and grading of the meat and fat for sausage production must comprise bacteriological tests and chemical analyses to check the rancidity of the fat and estimation of the fat content in the meat.

A quick method for evaluating the bacterial quality of trimmings is the resazurin test, the principles of which were outlined in the paper by Wilhelmssen at the 11th Meeting of European Meat Research Workers. In evaluation of the quality of the fat, the formation of peroxides may

be taken as a measure. The ferrithiocyanate method for estimation of peroxide number is modified to a spottest on filterpaper in which the appearance of a reddish colour indicates rancidity in the fat (peroxide numbers greater than 4.)

An effective control of fat contents of the trimmings is a rather difficult task. One way is to maintain a very fine and even cutting up procedure and to check the fat contents of the trimmings by analyses now and then.

Another one is to mix great portions of meat trimmings and to establish a sampling system and water and/or fat analyses by a rapid method (Ultra-x-analysis).

Grinding and Cutting

The treatment of meat and fat in the grinding and cutting machines are to a great deal determining for the appearance and texture of the sausage and as the spices and curing ingredients are also added during this procedure, this production step is also of outmost importance for the taste and flavour of finished product. There is a lot of possible variations in the cutting and mincing procedure influencing the quality of the sausages. I should like to draw the attention to one problem, namely the salt distribution and salt to water proportion in the forcemeat. We have found that unless outmost care is taken by the addition of salt during the cutting we get an uneven distribution from point to point in the forcemeat in the bowl, differences of 1-2 per cent of salt contents may easily be found. This in turn gives a variation in the proportion of salt to water of 2-5 units accounted on a water content of about 40 per cent. This means that sausages made from the same cutting batch get different starting points for the following steps, the brine cure and/or the drying process.

Brine Curing

A cure in brine is a common procedure in many Danish factories. The brine used has a strength of 16 - 18° Be or even more and it sometimes contains nitrate and nitrite. The curing takes from 4 - 20 days and the temperature of the brine should be about 8°C. This curing process may have a detrimental effect on the variation of the salt to water proportion among sausages and in the sausages. The reasons for this are the following: When sausages are stacked into compact blocks, there will be a lack of circulation of the brine and the temperature of the sausages will be low compared to brine temperature. It is found that the diffusion rate of salt is becoming very low at temperatures below 5°C, meaning that practically no curing is taking place. It is rather common that the temperature of the sausages after stuffing, when they are placed in the brine vats, is about - 2°C. Temperature measurements in sausages at different places in vats show that it takes about 3 days for the temperature to reach 7°C in sausages placed in the center, while sausages near the surfaces are tempered and ready to take cure after one day. These results are at room temperatures of about 10°C and with no forced circulation and heating. This gives, of course, great variations of salt to water proportions in different sausages. By applying a forced circulation and a gentle heating of the brine during the first day of curing a substantially improvement in evenness of salt to water proportion among sausages is found.

Another point is that in the single sausages the difference between salt to water proportion in the center and outer is rather big after the brine cure (3 - 5 units). Meanwhile this difference is to a great extent levelled out during the subsequent drying and smoking process which is not the case by differences among sausages.

Drying and Smoking

The drying and smoking process are an essential part of a dry sausage production. It tends to transfer the sausages into a stable product with a firm texture and an outstanding keeping quality. The preserving factors are the increase of the salt to water proportion, fermentation and the effect of the components of the smoke.

Though, most of the dry sausages produced in Denmark are not fermentated, the keeping ability are only based upon the salt concentration and smoking. A necessary salt to water proportion is here about 22 g per 100 g water, and the pH in these sausages are about 5.8 - 6.2.

The factors governing the drying velocity can be divided into two groups, namely those of the sausage itself, and those from the drying condition. In the first group the important ones are water contents, calibre (diameter of sausage) and pH. The second group of parameters, those of the drying procedure, are the temperature, the humidity and the velocity of air.

Now, having a sausage of a specific type it may be found by model experiments: how big is the ultimate weight loss during drying and what is the optimum drying velocities during the process, this means how fast can it be without damaging the texture (overdried outer layers) and how slow may it go at the specified temperature without danger of growth in the initial face of the drying where the salt to water proportion is rather low. The curves in Fig. 1 will give an impression of the length of this face for brine cured sausages and for sausages dried without preceding brine cure.

In fig. 1 is showed 3 curves giving relation between weight loss and salt to water proportion, curve 1 and 2 are for two different sausages of the same type and production (both brine cured for 6 days). Curve 3 is for another

sausage type (Farmers' salami) which is not brine cured. Curve 1 and 2 are showing the extreme case where there is no levelling out between the salt to water proportion among the sausages during drying. In practice there will, of course, be some levelling out at least in the smoking period.

Fig. 1 also comprises a curve showing the equilibrium relative humidity (per cent ERH) as a function of g NaCl per 100 g water in sausages. If only sodium chloride was present in the sausage we would expect a NaCl solution of 36 g/100 g water giving 75 per cent ERH, but the presence of soluble protein and other salts in the water face of the sausage gives a value of about 69 per cent ERH.