FROM RAW HAM TO A GOURMET DELICACY

Thanks to state-of-the-art technology, CLIMA*jet* cold smoking and maturing systems ensure ideal production conditions.

The production of dry salted raw ham or products similar to raw ham can be traced back to prehistoric times. Today, state-of-the-art production equipment like Schröter's CLIMA*jet* line is used to transform ham into a gourmet delicacy.

The Celts tried to increase the shelf life of their meat products by salting them. However, it wasn't just the Celts in Europe who discovered that salting and drying preserves meat products: Native Americans in North and South America also used salting and smoking to preserve the wild animals they killed. The North American Indians made so-called "pemmican," the basis of today's popular "beef jerky" snack, later adopted by the early European settlers.[1] In South America, it was probably Indios in Peru who used the sun, salt, and the cold air at altitude to turn venison and llama meat into long-lasting "charqui."

The "technology" of salting was widely used, not just in America, but also in Africa. Native inhabitants of Africa made "Biltong Beef," which is still a trendy snack today and became particularly well known during the Soccer World Cup in 2010. While the products available in Europe are made mainly from beef, the "original" product is more likely to be made from ostrich, kudu, springbok, or zebra. Later on, salted meat enabled longer sea voyages to be undertaken because it allowed these products to be stored for a long period, ensuring that sailors could be provided with the all-important protein they needed.

THE BIRTH OF A SPECIALTY

Over the course of the years, a virtue was made out of a necessity: the preservation of meat was increasingly transformed into the manufacture of a specialty. Areas with lots of salt deposits and a favorable climate were predestined for the manufacture of ham. One example is the region around San Daniele. Here, the cold air fronts meet the warm winds from the Adriatic, providing an ideal and balanced climate for ham manufacture. Coupled with the nearby salt marshes in the Adriatic, where seawater was evaporated in large basins to produce sea salt, and the fertile Po Valley in which pigs were fed, this led to the creation of San Daniele ham, loved by gourmets for centuries.[2] Thanks to world trade links, such local raw-ham specialties are today known across the world and are available everywhere.

MANUFACTURING TECHNIQUES IN THE 21ST CENTURY

In 2011, manufacturing technology is based mainly on preserving meat by reducing the water content (relative/absolute) by drying and adding salt, just as the Celts did during the Iron Age. Raw ham is stable when it has an a_w value of less than 0.96, which is the equivalent of a salt content of 4.5 percent.[3] Preservatives in the form of nitrate and nitrite both preserve the food and lead to the formation of the curing pigment nitrosomyoglobin.

[1] Cf. Wikipedia.org/Beef Jerky
[2] Cf. prosciuttosandaniele.it
[3] Cf. STIEBING, Handbuch Fleisch und Fleischwaren

During this biochemical process, nitrate must first be reduced to nitrite. The low-level microbiological activity is less intensive here than in raw sausage manufacture, for example. The nitric oxide produced from nitrite during the reduction process and/or acid-catalyzed decay sets in motion further reactions with substances in the meat itself, as well the reaction with the muscle pigment myoglobin. The reaction products include flavor and olfactory derivatives. Furthermore, the nitrate is highly effective at preventing germs by making it difficult for individual enzymes to form and oxidative phosphorylation in carbohydrate metabolism to occur. It also binds iron and influences electron transport.[4] With raw ham that has been matured for a long time, prevention of rancidity (autoxidation) is of major importance. A reaction product of nitrite is responsible for this. The nitrogen dioxide that forms attaches to the double bonds of the unsaturated fatty acids, and also binds pro-oxidative divalent cations.[5] For the reasons mentioned above, good salt distribution within the raw ham is as important as choosing the right temperature during the salting and maturing process.

THE RAW MATERIAL IS WHAT MAKES THE HAM

When choosing the raw material, it is important to focus on its characteristics. The pH value should be ≤5.8 because this will have a considerable influence on diffusion behavior and thus the curing potential of the raw material. A higher pH value has an effect on germ dynamics, meaning that raw materials with a higher pH value are more microbiologically unstable.

A further important point is the initial germ content of the raw material. The rule is: the lower, the better. In general, it is recommended to classify raw material suppliers according to the CFU content per sq cm. Cooling meat quickly following slaughter, cool storage, and hygienic and cold transportation help to ensure low initial germ loads. Furthermore, raw ham should be cut smoothly and cleanly, with no grooves. Weight and fat content should be as evenly distributed as possible to ensure even absorption of salt.

DEEP-FREEZING AND SALTING

Some manufacturers swear by deep-freezing before salting. This has been proven to improve salt intake during curing and water removal during drying (LAUTENSCHLÄGER, 1995). This is due to the fact that during freezing, large ice crystals form, which cause mechanical damage to the cytoplasmic membrane of meat cells. This means that cytoplasm (water content approx. 80–85 percent) can flow away more easily during the thawing process. Salt and preservatives diffuse better through the partially damaged cell wall and water removal is also optimized. The thawing process, however, carries a higher microbiological risk if it is not carried out in accordance with strict hygiene rules. In addition, not every manufacturer has the capacity to do this. The longer the meat remains frozen, the higher the autoxidative susceptibility of the fats. This should be borne in mind when deciding on duration of storage/freezing.

Salting is carried out either manually or in a tumbler or other automatic mechanical device. These devices enable the salt content to be dispensed precisely according to weight and help to standardize the salt content in end products better than if the meat were salted by hand. Depending on length of time taken to salt the product and the amount of salt used, there may be a considerable increase in the salt concentration in the outer edges (LAUTENSCHLÄGER, 1995).

The ham can run through all of the production steps lying in wire bowls.

FROM FERMENTATION AND MATURING TO THE DELICATESSEN

The next step in the process is what's known as "fermentation," which gives the different levels of salt in the surface areas and core of the product time to balance out. The concentration gradient means that water now diffuses from the core to the edges and the salt content continues to equalize inside the ham. After a certain period of time, a balance is achieved. The length of this process can vary depending on the size of the ham (diffusion distance), the characteristics of the original material (pH value, redox potential), and the salt concentration in the surface areas.

During the salt equalization process, several complex biochemical reactions take place in the ham. Carbohydrate is broken down by proteases and fat, among other processes. Nitration reactions also take place. These processes have an effect on the sensory characteristics of the raw cured product. As the ham is not yet microbiologically stable at the time of fermentation, the process should be kept at a maximum of 5° Celsius until the core has attained the desired salt content. These discoveries were made by LEISTNER (1983) and WIRTH (1985).

[4] Cf. ebd.
[5] Cf. W.BALTES, Lebensmittelchemie

In recent years, the "cold drying" process has garnered increased attention from ham manufacturers. This technology reduces the fermentation period by a quarter to a third and adds an additional cold-drying step. During the fermentation period, the meat is "fermented" at 4 to 5°C and a relative humidity of 80 to 95 percent (depending on the desired surface quality). In contrast, in the cold-drying process the relative humidity can be lower than 70 percent, depending on the product. With this drying process, the value of a_w is 0.92–0.91 instead of the usual 0.97.[6] As a result, the raw ham already dries before entering the maturing phase. This makes the process significantly safer, since the growth of pathogenic germs in the Listeriaceae and Staphylococcaceae families is effectively inhibited early on.

THE CLIMA*jet* MAKES IT POSSIBLE

CLIMA*jet* cold-smoking and maturing systems, which include Multi-Air-Flow technology and a fermentation feature, are perfect for all of these applications. Each step of the process, such as fermenting, cold-drying, conditioning, smoking, and maturing can be carried out on this machine safely and efficiently without requiring a large number of employees – either as a continuous process or each step individually. After being salted, the ham is placed in wire baskets on the smoking trolleys, is showered off, and then transported into the system. Afterwards, the operator starts the desired program, which is tailored exactly to the product's specifications. To ensure maximum repeatability, the system has a high-precision air intake system as well as a number of air circulation options that can all be selected freely. The air intake system continuously measures the thermal conditions of the fresh air or the outside air, if applicable, and then analyzes whether it would be more suitable for drying or humidifying. If this is the case, the continuously variable air intake flap regulates the amount of fresh air being fed into the system. This results in significant energy savings, since both the cooling and heating devices can remain off. Air circulation can be tailored exactly to the product by adjusting the speed (which is continuously variable) and the length of the air intake periods (both horizontal and vertical intake) with the corresponding adjustment to the return air intake.

The "Intouch" process display software supports complete traceability of all products, as is required by industry-specific quality management standards and regulations. This easy-to-use and clearly arranged program allows operators to monitor all systems and processing steps at any time. A wide variety of additional applications are also available. For example, a floor scale built into a chamber can be integrated into the system's controller, which allows the process to be adjusted according to the weight loss occurring at any given moment. In addition, air intake filters, air decontamination devices, and other components customized to meet customer needs are also available. This system offers maximum flexibility and the best process results, because it also ensures that even long-matured and short-matured raw sausages will always turn our perfect. Schröter's CLIMA*jet* lines are always an excellent choice for manufacturers of high-quality ham and raw sausage products, because in addition to time and material quality, the air conditions and maturing conditions play a key role in determining whether a product becomes a delicacy, or simply remains a standard product.

André Budesheim is the person to talk to when it comes to technical questions. You are more than welcome to send your questions to **praxisfragen@schroeter-technologie.de**.

[6] Cf. Mittich et al. 2009