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Ham Curing with Rapid Cooling

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The chilling of fresh killed meat is generally achieved by air cooling. The same applies to the cooling of hams. The chilling of meat is a means of controlling the physico-chemical and microbial processes, therefore in choosing the method of chilling , the subsequent application of meat and the special requirements of each manufacturing process have to be borne in mind.

It is general knowledge that fresh killed meat is a very good medium for the growth of microorganisms. A thorough chilling of meat at an appropriate phase of treatment may inhibit the reproduction and biochemical action of microbs.

On the other hand it is also well known that meat becomes palatable only after a period of aging during which a series of chemical reactions take place. Is the aging carried out at an elevated temperature it may terminate in the spoilage of the meat. Thus the aim of chilling is to decrease temperature and thereby control the process of aging.

The rapid reduction of body temperature depends on the heat transfer coefficient, in other words, how fast heat is transmitted to the cooling medium. From $Q = x\ F/t_2-t_1/$ follows that the amount of transferred heat may be increased by increasing the temperature

difference, by the enlargement of the surface and by the application of a suitable cooling medium.

The temperature of the meat is usually given, therefore the increase and with it the transfer of a larger amount of heat may be achieved only by the application of a medium of lower temperature. In air cooling by reducing the temperature of the air the rate of chilling may be accelerated. However that necessitates a lower evaporation temperature, but this may not be arbitrarily reduced. For the lower the evaporation temperature, the less economical is the refrigerator operation.

Another way of improving heat-transfer is the increase of the surface of meat to be chilled. However this is impracticable when the meat to be chilled has to remain in wholesale cuts.

The heat transfer coefficient may be increased by replacing the air as cooling medium by a fluid. For the heat transfer coefficient of fluids is much higher than that of gases. In order to avoid damaging the meat by the medium, the fluid applied for cooling has to be chosen in accordance with the character of the goods to be cooled. The cooling medium may penetrate the meat for instance when meat is chilled in brine. The disadvantage of chilling meat in brine is that the salt penetrates the tissues and at the same time the surface of the meat becomes discolored. That is whay brine is seldom used for the direct

cooling of meat.

The physical and chemical changes occuring during brine cooling in meat are of disadvantage in case of wholesale cuts but meats to be cured and particularly hams are not affected adversely. These considerations lead to the experiments concerning the rapid cooling and curing of hams in brine /using sodium chloride and sodium nitrite/ and carried out at the Institute.

A brine of 22° Bé cooled to -10° C was used for the experiments. The method used was as follows: fresh hams trimmed of fat, 7 to 8 kg of weight and of 39° C body temperature were stitch pumped with brine about 8 to 10% of their green weight. By this operation the core temperature of the ham was reduced to 33 to 34° C. The warm cured hams were chilled in a circulated pickle of -10° C for 2 hours. During this period the surface was cooled to -2° C while the core temperature decreased to +10°C. At this stage pickling was interrupted, the hams were placed in a chamber of 0 to 1° C temperature. The temperature throughout the whole ham became equalized within 1.5 - 2 hours and the final temperature of surface set at +1°C, whereas that of the core at +5° C.

Figure 1. Cooling Curve of Ham

Hams thus treated were piled in a chamber of +5°C and 3 days become adequately aged. For the aging of shoulders 1.5 to 2 days are

needed. The canning and cooking of the hams is carried out according to the customary practices. The cans opened on the seventh day after cooking day after cooking contained 1o.5 to 14% jelly. Organoleptic tests proved that the colour, taste and consistency of the hams thus produced equalled that of the hams produced by traditional methods. From the bacteriological point of view the hams were satisfactory, mostly sterile. Very few of the hams reached the cell count of 10^1.

It may be concluded that hot curing followed by rapid chilling in brine not only does not affect adversely the product but on the contrary, effects a ham of high quality.

It has been known for long that by hot curing the curing time may be reduced. Experiments are described in related literature where too cold brine was used for chilling the fresh ham. While in the first case the experiments were not succesful because of the development of cookedness, in the second case the tissues were frozen. However in the experiments described above no such phenomena disturbed curing.

During the cooling period significant structural or chemical changes were not observed, exept for the increase of density and viscosity of the cellplasm. No loss of weight as a physical change occured during cooling in brine.

This method of hot curing and subsequent chilling in brine requires a new ham production technology. The pig halves arrive from the slaughterhall by an overhead conveyor. The hams and shoulders are cut off

and on a table, provided with a conveyor belt, prepared for curing. After stitch pumping they are placed on frames and carried by an overhead conveyor to the chilling tanks and submerged there. The rate of advance of the overhead conveyor is set to fit the prescribed chilling time. Thus the cooled hams arrive at a continuous rate into the aging room. This room serves to equalize temperature in the ham and there the aging takes place.

The refrigeration requirement of the ham cooling equipment of a plant processing 600 pigs per day, consisting of a 1.2 x 1.2 x 16 m tank lined with plastic material, is approximately 45.000 KCal per hour. 2 hours being sufficient for cooling, on 20 conveying frames 600 hams or shoulders may be cooled at a time.

It may be concluded from the above experiments that by hot curing and subsequent chilling the meat retains its comparative sterility because the total time requirement of pickling and chilling is not more than a few hours. The microbs which land on the surface of the ham have no time to proliferate. They have no chance to penetrate the tissues and thus the danger of microbial spoilage is totally eliminated.

By this method precooling and cover pickle become superfluous hence precooling rooms and pickling rooms are not wanted either, and production compared to the previous practices becomes more profitable.

By saving the precooling time, the transit time of ham

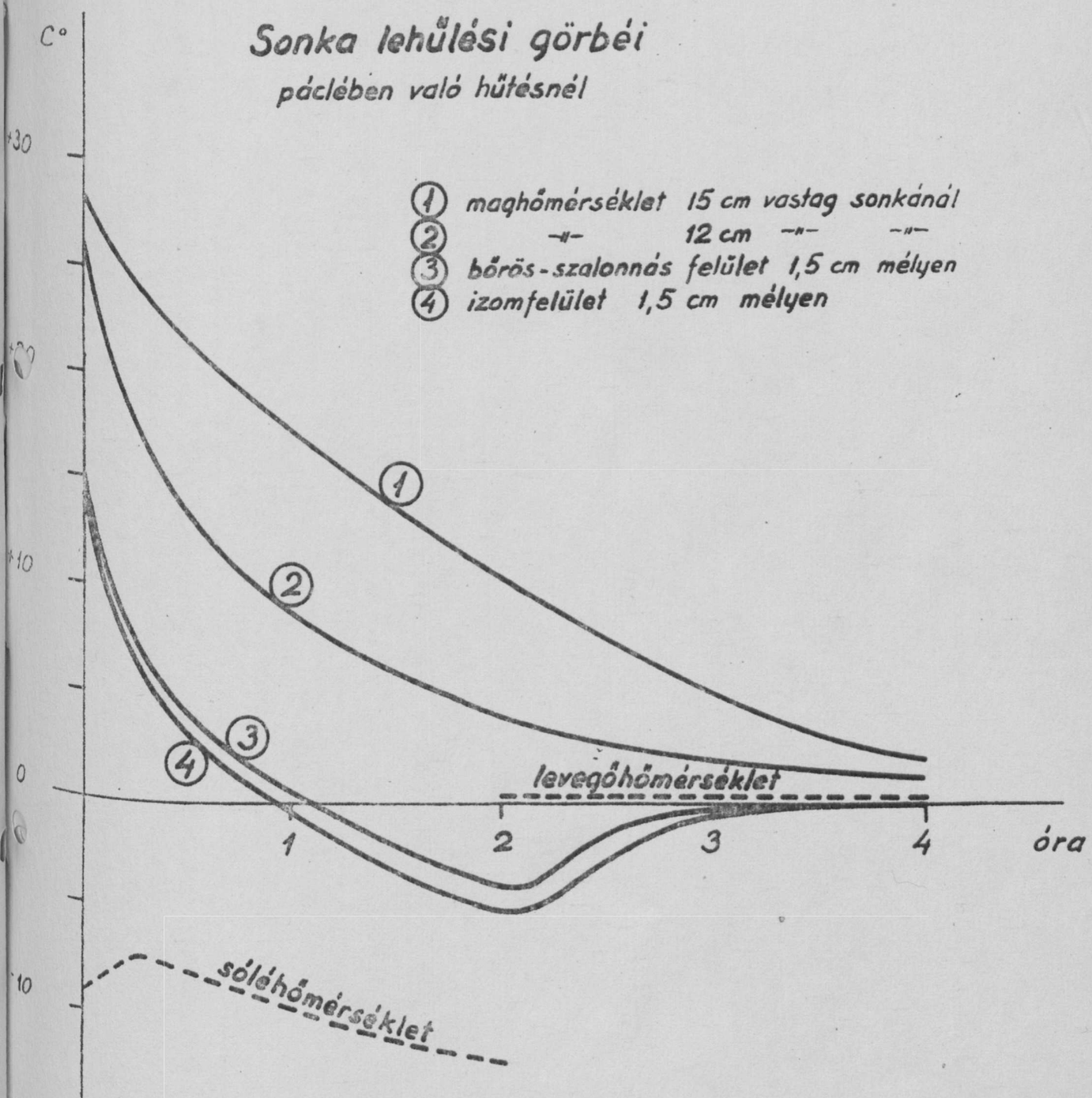
production is substancially reduced. By applying circulated cooling brine the heat transfer losses are minimized.

The whole process my be mechanised. The repeated handling of the goods becomes superfluous and thereby the manhour requirement is also reduced.

A further advantage of the new process is, that it may be realized in every ham processing plant without difficulty and necessitates comparatively little investment with a short time of amortization.

Sonka lehűlési görbéi

páclében való hűtésnél



Schinkenpökelung mit Schnellkühlung

Kassai und Gy. Kárpáti

Es wurde zur Qualitätsverbesserung der Press- und Dosenschinken und zur Abkürzung der Durchlaufzeit der Schinkenherstellung ein neues technologisches Verfahren ausgearbeitet. Als Grund der Untersuchungen diente jene Erkennung, dass die Abkühlungszeitdauer in einem entsprechenden Vermittlungsmedium in bedeutendem Masse abgekürzt werden kann, wenn die zum Pökeln bestimmten Fleischstücke anstatt der traditionellen Luftkühlung mit Pökellake bedeckt -unter besseren Wärmeübertragungsverhältnissen- gekühlt werden. Bei diesen Waren wirkt nämlich die während der Kühlung in das Fleisch eindiffundierende Salzlake nicht nachteilig auf die Qualität des Endproduktes aus.

Die von halbierten Schweinen abgeschnittenen Schinken werden geformt, alsdann in körperwarmen Zustand mit Spritzlake gepökelt und in der auf -10° C abgekühlten strömenden Pökellake bis zu einer Kerntemperatur von + 10° C abgekühlt. Nach etwa 2 Stunden Schnellkühlung lässt man die Temperatur der Schinken ausgleichen, alsdann werden sie im Reifungsraum bis zum völligen Aus-

reifen 1.5 - 3 Tage gelagert.

Es wurde mit Versuchen und Versuchsherstellungen bewiesen, dass die in körperwarmem Zustand erfolgte Pökelung und die während der Schnellkühlung in Pökellake auftretenden physikalischen, biologischen und chemischen Änderungen die Qualität des fertigen Schinkens vorteilhaft beeinflussen. Der nach der neuen Technologie hergestellte Schinken erhält seine verhältnismässige Sterilität. Während der vom Schlachten bis zur Beendigung der Abkühlung abgelaufenen wenigen Stunden wird die Vermehrung der Keime nicht ermöglicht, wodurch die Gefahr des Verderbens völlig ausgeschaltet ist.

Beim neuen Verfahren fällt das Vorkühlen und Pökeln mit Decklake weg, wodurch die Vorkühlräume und die gekühlten Pökelräume überflüssig werden.

Die Herstellung kann mehr kontinuierlich und in höherem Grad mechanisiert durchgeführt werden. Die mehrmalige Umladung und Förderung wird vermieden. Die Einführung der neuen Technologie kann in den Betrieben ohne eine bedeutende Investition leicht realisiert werden.

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Summary

A new method was worked out to improve the quality and reduce the production time of cooked and canned ham. The basic principle underlying the method is that production time may be substantially reduced by choosing a suitable cooling medium.

The meat that has to be pickled anyway does not suffer any damage from being chilled in a brine instead of air as cooling medium. The curing salts penetrate the meat while being chilled.

Hams removed from the pork halves are moulded, they are stitch pumped at body temperature, then they are cooled in a circulated brine of -10° C temperature till a core temperature of $+ 10^{\circ}$ C is reached. After about 2 hours the hams are adequately chilled, they are removed from the brine and piled. In about 1,5 - 3.0 days the temperature of the hams becomes equalized and the ham is sufficiently aged.

It was proved first in experiments, later in pilot scale production that the physical, biological and chemical changes occurring in hams stitch pumped at body temperature and subsequently rapidly cooled in brine have an advantageous effect on the product.

Hams produced by this new technology retain their comparative sterility. In the short period between killing and the end of the chilling process there is no opportunity for the growth of microorganisms, therefore the danger of spoilage is completely eliminated.

The application of precooling and curing in brine becomes superfluous thus precooling rooms and refrigerated curing chambers are also dispensed with. Production is continuous and may be mechanized. The man-hour requirement may be reduced. The introduction of the new system may be accomplished without great investment.

В Ы В О Д Ы

к докладу "Посол ветчины в комбинации с быстрым охлаждением".

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Авторы разработали новый способ технологии улучшения качества ветчины и окорока и сокращения времени производственного цикла.

Основой исследований служило распознание того, что выбором охлаждающей среды значительно можно сократить время охлаждения продукта, если мясо подлежащее посолу, взамен традиционального воздухоохлаждения, будет охлаждаться погружением в рассол имеющий хорошую теплопроводность, так как на эти мяса соляной раствор диффиндируемый в продукт во время охлаждения не оказывает отрицательное влияние на образование конечного продукта.

Из полутуши отрубленную ветчину формируют, потом ещё в тёплом состоянии производят посол ветчины шприцованием и в рассоле охлажденном на $-10^{o}C$ охлаждают ветчину до $+10^{o}C$ ядерной температуры.

Потом приблизительно после двухчасового ускоренного охлаждения производят уравновешивание температуры ветчины и в созревательном помещении хранят мясо I,5 - 3 сутки до окончательной зрелости.

Экспериментами и опытными производствами доказали, что физические, биологические и химические изменения происхо-

дящие вследствии посола ветчины в тёплом состоянии и быстрого охлаждения в рассоле, положительно влияют на качество готовой продукции.

Ветчина обработанная по новой технологии сохраняет свою относительную стерильность. В протяжении нескольких часов от убоя до конечного охлаждения продукта, размножение зародышей становится невозможным и таким образом вполне прекращается опасность порчи.

По новому способу посола становится излишним предварительное охлаждение и мокрый посол ветчины и устранится необходимость применения пространства предварительного охлаждения и холодных посолочных помещений.

Применением нового способа посола организацию производства ветчины можно сделать более поточной и механизированной. При этом способе можно избегать многократные перегружения и транспорты. Внедрение этого способа производства ветчины в действующих заводах, легко осуществим без значительных капитальных вложений.

Литература.

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List of Figures:

Figure 1.: Curves belonging to hams cooled in brine.

1 Core temperature in a ham of 15 cm thickness

2 Core temperature in a ham of 12 cm thickness

3 At a depth of 1,5 cm under skin and fat

4 At a depth of 1,5 cm under the surface of a muscle

---- Temperature of the air and the brine

The ordinate gives the temperature,

the abscissa the cooling time in hours.

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