Rapid and slow chilling of pork after slaughtering, under controlled climatologic conditions

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Introduction

Up to 1950 the chilling of pork after slaughtering was commonly effected by a slow two-phase procedure. At first the carcasses were moderately chilled during 24 hours at e.g. + 10 °C and 75 % relative humidity, followed by cooling down to 0 -4 °C in an other 24 hours under normal storing conditions (r.h. ± 90 %).

The drying of the surface as a result of this procedure was regarded as a favourable factor in depressing bacterial spoilage.

More recently much attention has been paid to the rapid chilling, within 24 hours down to 0 -4 °C, as already suggested by Tamme[1)] in 1930. Many modifications of this method have been published, all applying forced circulation of high humidity air (2-3 m/sec; 90-98 % r.h.), with variations in time and temperature from a few hours at - 10 °C to 24 hours at 0 °C.

The advantages of this type of chilling are claimed to be: lower evaporation losses as well es a better prevention from bacterial growth as compared with the traditional method.

The variety of modifications suggested in literature is largely due to the fact that most of the research has been done on industrial installations in slaughter houses, where only one climatic condition can be realized. Therefore, we felt the need for fundamental research on this subject. For this purpose we built a climate room in which controlled and variable climatic conditions can be realized. This room allows a study of the individual effects of variations in temperature, relative humidity and velocity of the air current on the quality of the stored carcasses.

1) Beiheft Zschr. ges. Kälteindustrie "Die Kälte", Reihe 3, H 4, 1930.

This paper only deals with the starting-programme of long-run investigations, after which we hope to have found optimum chilling conditions for pork and other meats. We shall describe here first the equipment and possibilities of the climate room, followed by a short description of our programme of research and some results.

The climate room

The dimensions of the climate room were chosen in such a way that two half pork carcasses or two quarters of beef may be handled. The air-conditioning is effected by a closed recirculating system (figure 1). Tempearture and relative humidity are maintained by a cooler and a heater in series; the air in between is saturated by spraying water.

The system is principally controlled by means of two temperature pilots connected with two proportional pneumatic valves to regulate the cooling and heating capacity.

Pilot 1 controls the temperature of the cooled air after saturation, in fact the dew-point temperature of the conditoned air.

Pilot 2 controls the temperature of the air entering the climate room.

The air velocity can be varied by means of reducing the outlet of the cimate room and by changing the speed of the ventilator.

The installation is of course more complicate than described here. The capacity of the heater e.g. is in fact regulated by the difference in temperature of both pilots. This construction facilitates a more accurate stability of the relative humidity.

Further, provisions are made in order to keep the temperature of the cooling agent (glycol) at a constant level (within 0.1 ^{o}C), so that the cooling capacity can be accurately regulated by reducing or increasing the amount of glycol passing through the cooler.

The test results of this installation have shown that the climatic conditions can be varied as follows:

	range	accuracy
temperature	0 - 20 ^{o}C	$\pm$ 0.2 ^{o}C
rel. humidity	75 - 95 %	$\pm$ 2 %
velocity	0.5 - 2.5 m/sec	$\pm$ 0.1 - 0.5 m/sec

Programme of research

We have decided to start with a comparison of the two main types of chilling:

conventional slow chilling
modern rapid chilling

as they are both still used in practice.

We shall not only consider the chilling itself and the cooled storage of the carcasses , but also the subsequent storage of packaged parts under different conditions, in order to get a clear view of all possible differences in meat quality as a result of these chilling methods.

In this study we have chosen the following conditions for chilling and carcass storage, which we consider to be in good conformity with common practice.

	Slow chilling	Rapid chilling	Carcass storage
temperature	10.0 °C	0.5 °C	2.0 °C
rel. humidity	75 %	95 %	95 %
velocity	0.3 - 0.5 m/sec	2.0 - 2.5 m/sec	0.3 - 0.5 m/sec
duration	24 h	24 h	5 x 24 h

Every week two half carcasses are brought into the climate room within 1.5 hours after slaughtering. First, however, samples are taken for pH determination and for plate counts (swab method), the weights are recorded and thermocouples are brought in for periodical temperature measurements.

After applying the climate programme for 1, 3 and 6 days the carcasses are removed from the climate room for about 30 minutes. In order to take corresponding samples and to record the weight losses by evaporation.

As mentioned before, after the cooled storage of the carcasses some parts are packaged and stored again to see if there remain differences in meat quality as a result of different chilling methods.

In this first study most attention is paid to the aerobic storage of loin chops.

From each carcass eight loin chops are taken. Four are examined at once, the other four are laid on pulp trays wrapped in cellophane and stored during 4 days at + 3 °C before examination.

In each examination two loin chops are taken for bacteriological control (direct sampling), one for colour measurements (by the Hunter Lab Color and Color Difference Meter, a photoelectric tristimulus colorimeter) and one for determination of the waterbinding capacity (centrifuge-method of Wierbicki and press-method of Grau and Hamm).

Parts of the leg are taken for vacuum packaging. They are stored for 14 days at + 1 °C. At the moment attention is only paid to the amount of drip in the packages after storage. In further stages of the research also the bacteriological aspects of vacuum packaging will be considered (possible influences of the chilling methods).

Some results

As only part of the research work had been completed when this paper had to be made up, no concrete conclusisons can be drawn yet. However, we have already noticed that there are indeed differences in bacterial growth and weight-loss both in favour of the rapid method. Until now, no indications have been found that there are marked differences in waterbinding capacity and colour of the pork before or after storage in cellophane film.

Temperature measurements have shown that there is a possibility to reduce the time of rapid chilling from 24 hours to 12 or 14 hours thus reducing weight-losses further.

We hope to be able to give more detailed information when this paper is discussed in one of the sessions of the 12th International Meeting of Meat Research Workers in Sandeford, Norway, this summer.

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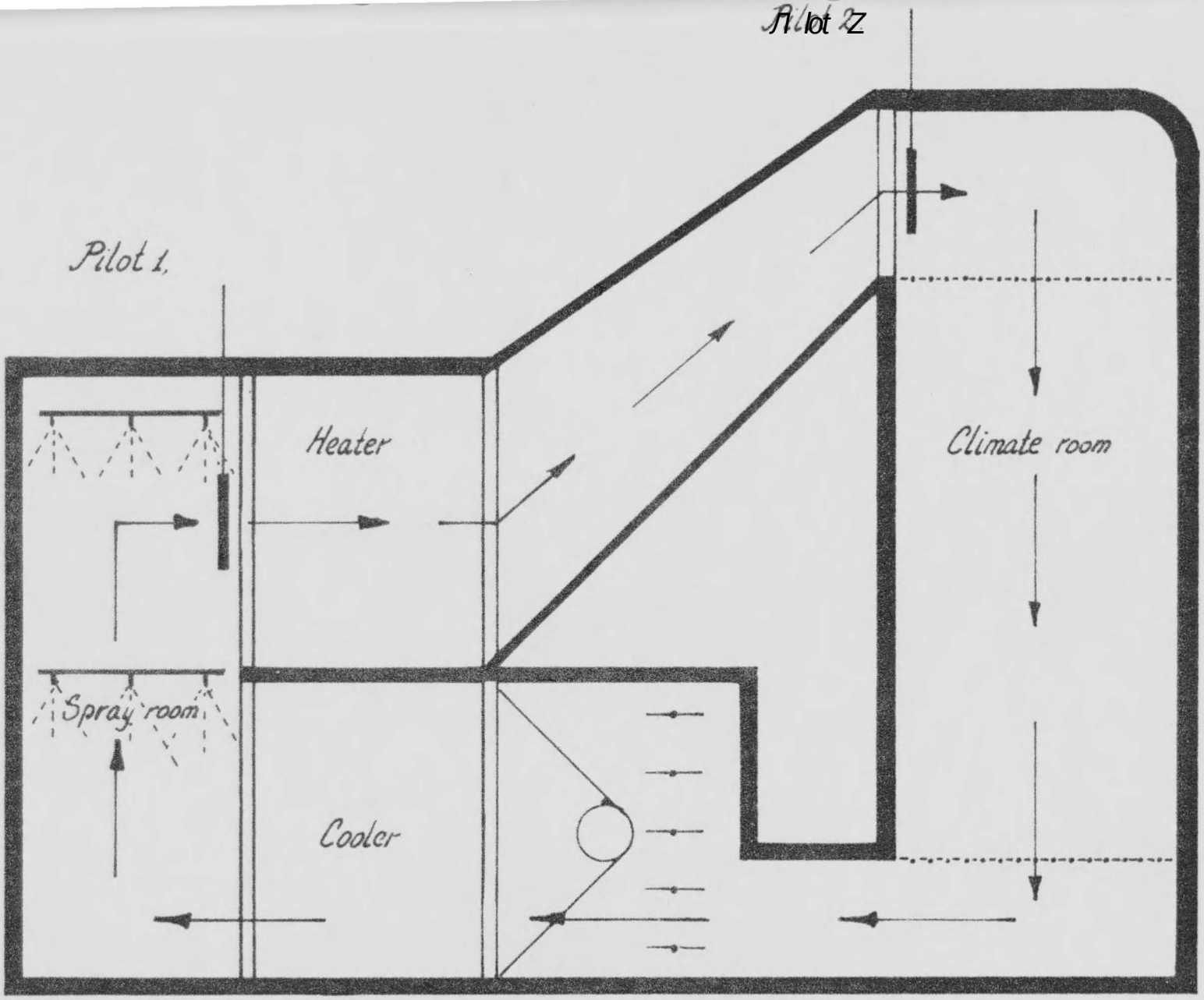

figure 1