PRODUCT TEMPERATURE IN CHILLED CABINETS

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INTRODUCTION

For the last 15 years there has been great interest in the temperature conditions in freezer cabinets although this has negligible influence on the product quality mainly due to the quick turn over of deep frozen foods.

The temperature conditions in chilled cabinets have not been examined very much, although it would have much more influence on product quality, especially the bacteriological quality if the product temperatures were 5 - 10°C higher than the desired level (about 5°C or lower).

The purpose of this experiment was to get knowledge about the temperature conditions in chilled cabinets in supermarkets in Copenhagen, and also to compare the measured product temperatures with the bacteriological quality of CA-packed ground meat.

MATERIALS AND METHODS

50 shops in Copenhagen were visited. In each shop temperatures were measured in several chilled cabinets, and in each cabinet 8 product temperatures should be measured, see fig. 1. The shops were normally visited in the morning to disturbe as little as possible.

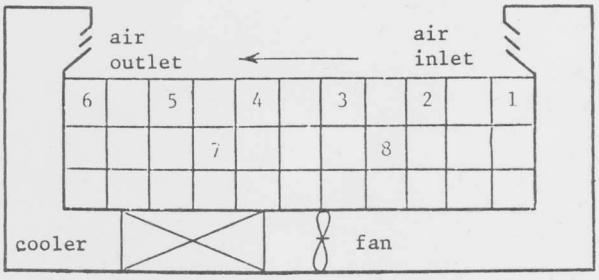

Fig. 1. Schematic cross-section of open-top cabinet, showing the position of the food products of which the temperature was measured.

The inlet air temperature and the room temperature (about 0.7 m above the floor, near the cabinets) was also measured; the mounted thermometre was read and speciel conditions as "defrosting", "night cover not removed", "filling up" etc. were registered.

The product temperatures were measured by means of an infra-red thermometre, IR-thermometre. There were two reasons for using this thermometre:

1. The speed of the measurement which minimizes the time for disturbance of the staff and the customers in the shops.

2. It is a non-destructive method.

The IR-thermometre is used by placing the instrument about 10 cm from the surface of which the temperature is to be measured, and after 2-3 sec. the reading can be taken. For plastic packages the temperature of the upper surface is measured, and then the pack is turned around to measure the temperature of the bottom surface. The average of these two readings is taken as the product temperature.

In each shop the product temperature of one package was also measured by placing a thermocouple in the center of the package.

For 11 packages of ground meat in CA i.e. packed in non-permeable plastic containers filled with 80% O_2 and 20% CO_2 the temperature was measured by the IR-thermometer and by a thermocouple. The packages were transferred to the laboraty where bacteriological analysis was carried out.

BACTERIOLOGICAL METHODS. 5 g of ground meat were taken out aseptically and mixed in a stomacher with 9 times as much peptone-saline.

Total count was determined on Plate Count Agar (PCA), after incubation at 30°C for 4 days.

Psychrofilic count: PCA, incubation at 7°C for 7 days.

Microbact. thermosphactum was counted on the surface of STAA (Streptomycin Thallium Actidion Agar) after 2 days at 25°C.

Lactobacillus was counted on the surface of Man-Rogosa-Sharp-Agar (MRS) after 2 days at 30°C.

RESULTS

The food products were divided into 9 product groups, and for each group the average temperature and the warmest temperature for the 8 points in fig. 1 were calculated. An example is seen in fig. 2, for precut meat in conventional retail packages.

Measuring point, see fig. 1	Upper layer						2. layer	
	1	2	3	4	5	6	7	8
Average temp. ^{o}C	2.7	5.0	5.9	5.7	5.4	5.7	3.6	4.2
Warmest temp. ^{o}C	8	10.5	10	11	10.3	9	9.1	8.5

Fig. 2 Product temperatures in 53 cabinets with chilled meat in conventional retail packages.

For other product groups the situation was rather similar to meat, although the product group "salad, mayonaise" was warmer than the other groups, perhaps because the products in this group are often stacked faulty, i.e. too high.

1061 product temperatures from the upper layer in horizontal open-top cabinets were used to construct the histogram in fig. 3, and the graph in fig. 4. The measurements in vertical cabinets were not used.

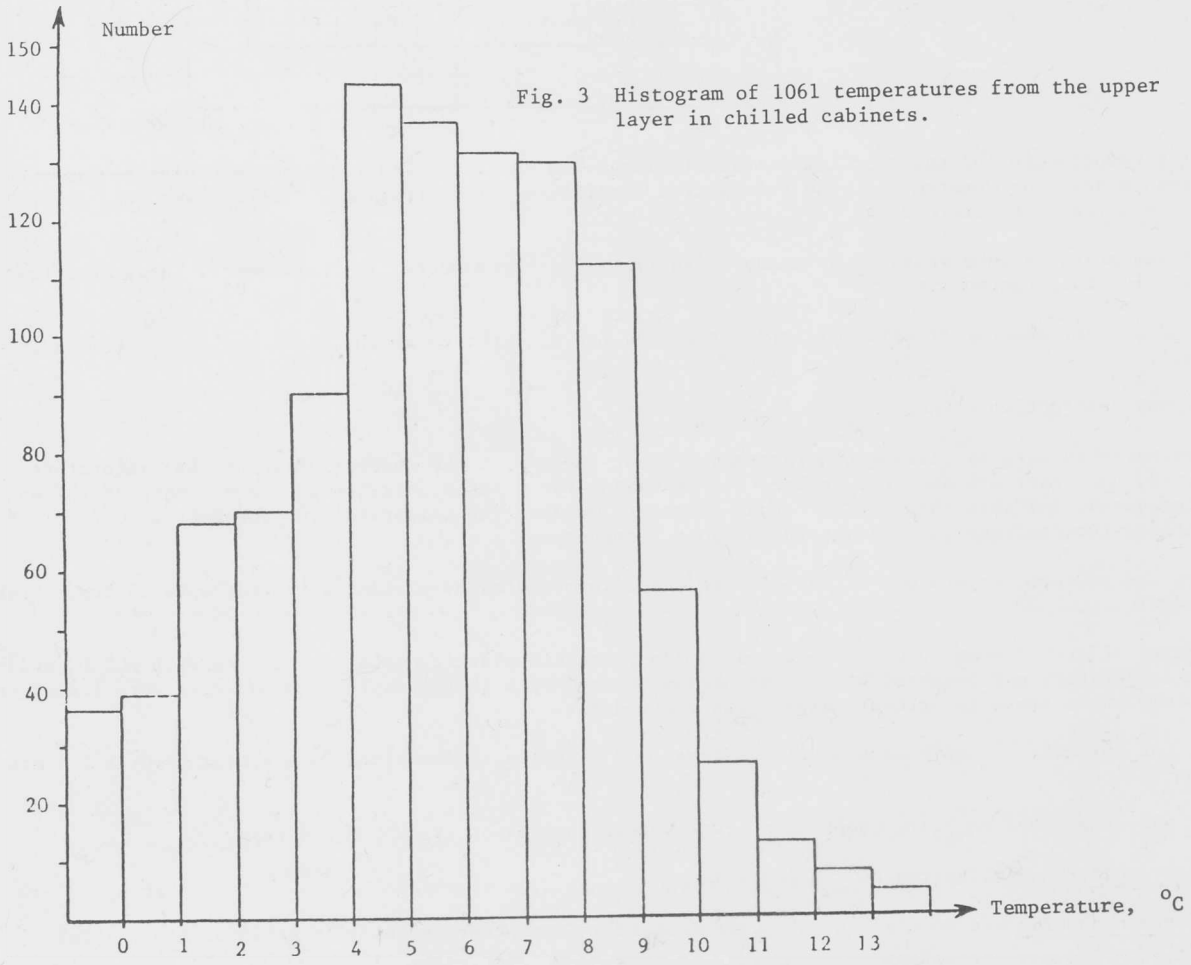

Fig. 3 Histogram of 1061 temperatures from the upper layer in chilled cabinets.

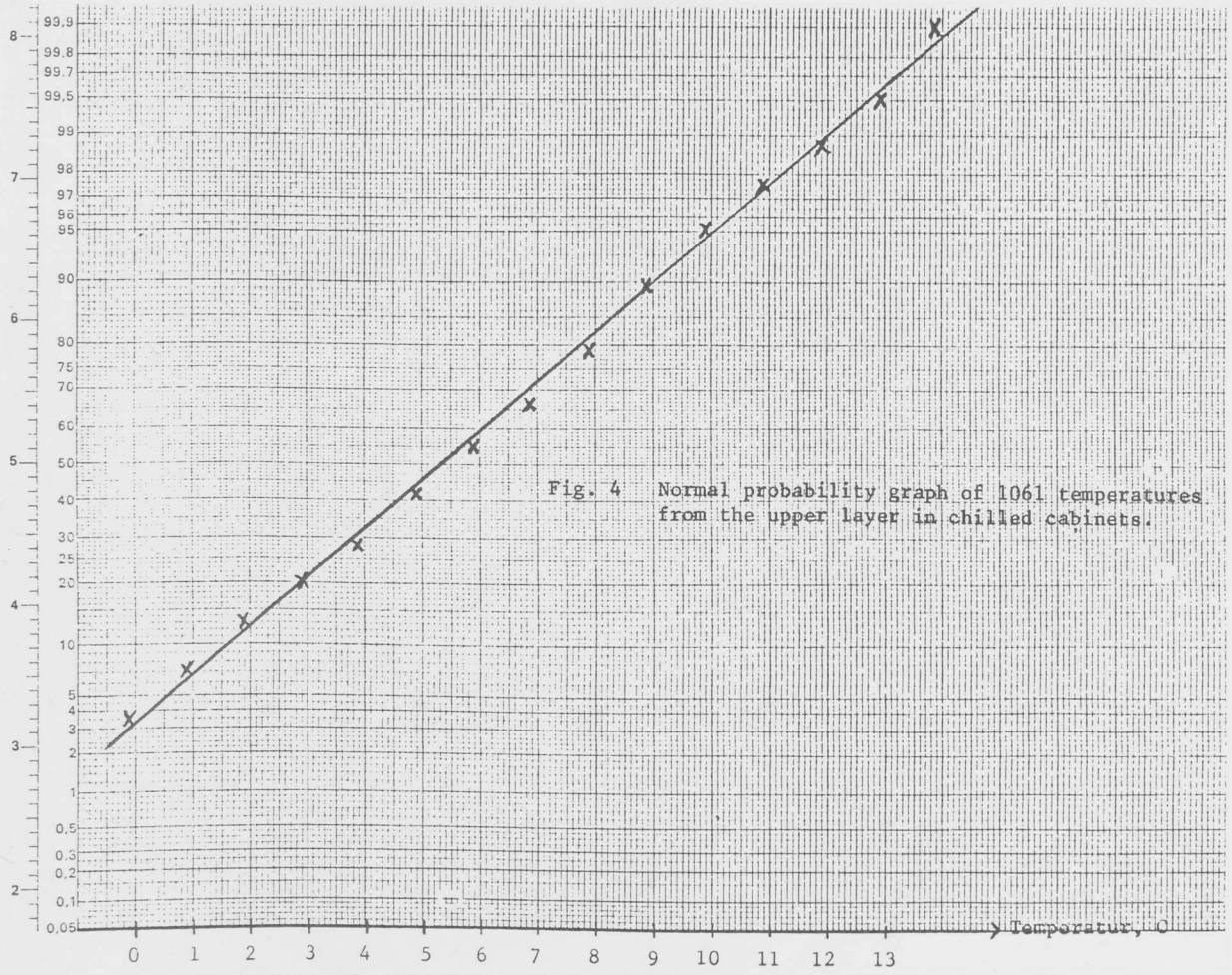

Fig. 4 Normal probability graph of 1061 temperatures from the upper layer in chilled cabinets.

No.	Days before last selling date	Product temp., °C	Total count		Microbac. thermos-phactum	Lactobacillus
			at 30°C	at 7°C		
1	4	5.0	8000	4200	1000	< 1000
2	2	5	62000	70000	50000	< 1000
3	4	2	52000	90000	50000	< 1000
4	4	3.5	45000	50000	38000	< 1000
5	6	3	1400	< 100	< 1000	< 1000
6	6	3.5	900	100	< 1000	< 1000
7	3	3.5	3500	770	< 1000	< 1000
8	0	7	34000	54000	21000	< 1000
9	0	5.5	9000	5700	10000	< 1000
10	2	3.5	18000	15000	13000	< 1000
11	2	3.0	3600	2200	5000	< 1000

Fig. 5 Bacteriological results from 11 packages with ground meat in CA-packages.

From fig. 4 it can be seen that 50% of the products in the upper layer are 5.3°C or colder, while about 19% are warmer than 7.9°C.

Moreover, chilled cabinets are defrosted at least once a day; a defrosting results in a rise in product temperatures in the upper layer of 2-5°C, and it will last 3-4 hours before product temperatures are normal.

On the other hand it will rarely be found that a food product spends more than a few days in the upper layer in a chilled cabinet.

These findings show that storage experiments with chilled food product should not be carried out at a constant temperature of f.ex. 4°C. In the Danish Meat Products Laboratory a constant temperature of 8°C is now used in this type of experiments.

MEAT IN CONTROLLED ATMOSPHERE. The product temperature and the bacteriological results are seen in fig. 5.

The sell-by date is 9 days after the packing date; an open date marking is used. It will be seen that 2 of the packages are bought on the sell-by day (no. 8 and 9) with very good bacteriological quality. According to Danish legislation the temperature of such ground meat should be 2°C or lower throughout, but it is seen here that only one (no. 3) is 2°C while the others are warmer.

CONCLUSION

Quite a number of temperature measurements have been carried out and it can be concluded that the temperature conditions in chilled cabinets in Denmark are: 54% of the food products in the upper layer are warmer than 5°C, while 10% are warmer than 9°C.

This should be taken into account when designing experiments with the storage life of chilled products to be sold in display cabinets.