Determination of the extent of heat treatment in canned hams with the phosphatase test

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USDA Guidebook /1983/ contains a method for the determination of core temperature of canned hams elaborated by Lind. Lind adapted the determination of the phosphatase activity described earlier by Körmendy and Gantner /1960, 1967/.
Lind found a close correlation between residual phosphatase activity and core temperature in 12 lbs oblong cans and proposed to determine whether the sample had reached the core temperature of 156 F^{o} /69°C/ in canned products.
However, the residual phosphatase activity depends in a general manner not on the core temperature itself but on the integral heat treatment of the core.E.g. 1 lb cans reach the required core temperature of 69°C more rapidly than 12 lbs ones, so the residual enzymatic activity can be considerably higher. The determination of heat treatment equivalents gives therefore a more precise concept from this phenomenon.

Materials and methods

Phosphatase activity has been determined according to the method of Lind as described in USDA Guidebook /1983/. Cured, tumbled raw ham samples with a NaCl content of appr. 3 % and a polyphosphate content of 0,5 % were randomly selected from the production line and minced through a plate with 3 mm holes, 20 g minced meat has been put in cellothen bags and sealed. The diameter of these bags was less than 2 mm to assure a rapid rise of temperature in the water bath.

These bags of small diameter were heated in water bath at constant temperatures of 60°C, 65°C, 70°C and 75°C for different times. After it they were immediately cooled in tap-water and stored in refrigerator for 24 hours before determination of the phosphatase activity. Activities were plotted graphically against time of heating at different temperatures, and the time necessary to reach the activity prescribed by Lind was determined:

$$\log/EF'/ = \frac{69 - 77,3985}{5,7109}$$

So the heat treatment equivalents at constant temperatures were determined with 2 replications.

Results and discussion

Figure 1 shows the relationship between time to reach the prescribed residual activity ($\log t_{69}$) and temperature /T/. The relationship is linear with a z value (cotangent of the line) of 5,85°C .
By knowing the heat penetration curve of a given type of can (core temperature vs. heating time) the curve of the necessary heating time can be determined on the following way:
The ordinate gives the reciprocal values of t_{69} ($1/t_{69}$)the abscissa the times to reach a given core temperature as determined from the heat penetration curve of the can (t). The necessary heating time is calculated from the area 1 under the curve /Fig.2/.
So the classical F_o and z concept can be used with the phosphatase test too. If we keep the original equation of Lind, canned hams with smaller sizes /e.g. 1 lb/ may not receive the sufficient heat treatment even if the core temperature reaches 69°C because the integral heat treatment is much less than that of 12 lbs cans.

References

1. United States Department of Agriculture, Food Safety and Inspection Service, Chemistry Laboratory Guidebook, 3oll, 3-27 /1983/.
2. Körmendy L. and Gantner Gy.: Über die Säure Phosphatase desFleisches. ZLUF 113 /196o/13/.
3. Körmendy L. and Gantner Gy.: Neuere Angaben über die säure Phosphomonoesterase des Fleiches. ZLUF 134 /1967/141.

Fig.1. Relationship between time ($\log t_{69}$) and temperature /T/ of residual phosphatase activity.

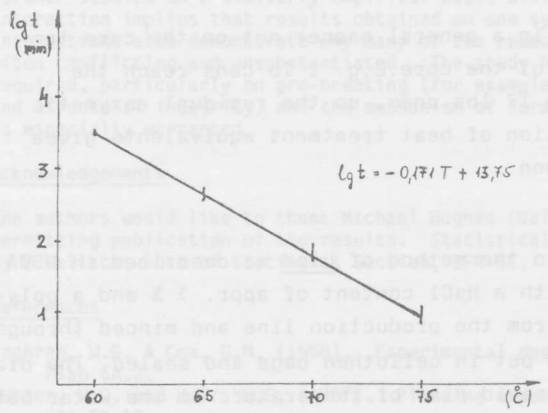

Fig.2. $\frac{1}{t_{69}}$ v.s. heating time in the core of 4 lbs can.