Possibility for determination of the commercial storage time of pork and beef on the basis of the work of Wenzel, Srerod and Gissel

G. SELMECI[1], G. GALAMBOS[2]

1/ County Food and Chemical Control Institute, Szeged, Hungary
2/ József Attila University, Szeged, Hungary

The duration of the period during which commercially distributed packaged and non-packaged meats remain consumable is of importance from the views of both the consumer and the trader.

Methods suitable for establishment of the freshness of meats and for determination of the criteria of consumability are generally connected with biochemical changes in the meats post mortem. Of the literature methods, the combined determination of ammonia, pH and porphyrin /INGR, 1977/ and the examination of the decomposition products of adenine nucleotides /WENZEL, GISSEL, SRERÖD, 1975/ are of practical importance.

We have carried out studies relating to the determination of the metabolites of adenine nucleotides. The team of WENZEL made wide-ranging analytical investigations of the hypoxanthine and inosine contents of various porks and beefs in differenc post mortem states. Their processing of several hundred experimental data led to the following conclusions:

1/ There is a correlation between the quantities of adenine nucleotide decomposition products, the storage time of the meats and the temperature.

2/ There are significant differences between the quantities of the adenine nucleotide metabolites and the post mortem pH of the meats for the different animals and meats in question.

3/ There is a close correlation between the hypoxanthine contents of the meats and the pH.

Utilizing the analytical data published by WENZEL et al., we have investigated the biokinetic correlation of the decomposition products of hypoxanthine and the adenis nucleotides.

A control method reasonably suitable for all types of meats would be of great importance from the aspects of controlling the comsumability and storage time of commercially distributed meats. Under the assumption that the decomposition of inosine and the formation of hyposanthine proceed via similar biokinetic pathwaxs in all types of meat at a given temperature, we hoped to find stricter correlations than those outlined above, that would be suitable for our porposes. The following parameters were considered:

$Hx_{1,2,3,...,n}$: hypoxanthine concentration in meat 1, 2, 3, ..., n days post mortem /μg/g/;

$1/Hx_{1,2,...,n}$: reciprocal of the former parameter /g/μg/;

$\frac{In_{1,2,3,...,n}}{Hx_{1,2,3,...,n}}$: inosine concentration in meat 1, 2, 3, ..., n days post mortem, divided by the hypoxanthine concentration.

Our examinations were performed with mixed porks and beefs stored at various temperatures /o-10°C/, setting out from the earlier chemical analytical data /WENZEL et al., 1975; 1972; SRERÖD, 1973/.

Table 1 presents the linear correlations between the parameters calculated for mixed pork stored at 5°C or at 10°C and the duration of storage.

Table 1. Correlation between hypoxanthine and inosine indices and duration of storage in the case of mixed pork

Index	Storage temperature, °C	Regression equations and correlation coefficients days 1-9	r^2	days 1-14	r^2
$Hx_{1,2,....,n}$	5	y=23,68x + 28,52	o,95	y=-o,82x + 212,7	o,27+
	10	-	-	y=23,44x + 6o,o6+	o,91
$1/Hx_{1,2,...,n}$	5	y=-o,oo13x+o,o2	o,93	y=-o,ooo83x+o,o1+	o,82++
	10	-	-	y=-o,ooo78x+o,o1+	o,77
$\frac{In_{1,2,3,...,n}}{Hx_{1,2,3,...,n}}$	5	-	-	y=-o,67x + 8,32+	o,85++
	10	-	-	y=-o,65x + 7,41++	o,75

\+ : days 1-13
++ : days 1-12

The following exponential function with the correlation r^2 = o,91 can be fitted to the numerical series $Hx_{1,2,3,\ldots,n}$: $y = 49.8.e^{0,15x}$

Table 2 presents the corresponding linear correlations for mixed beef stored at o-2 °C or at 7 °C.

Table 2. Correlation between hypoxanthine and inosine indices and duration of storage in the case of mixed beef

Index	Storage temperature, °C	Regression equations and correlation coefficients days o-3o	r^2	days 1-13	r^2
$Hx_{1,2,3,\ldots,n}$	o-2	y=6,18x + 55,49	1	-	-
	7	-	-	y=15,63x+17,48	o,99
$1/Hx_{1,2,3,\ldots,n}$	o-2	y=-o,oolx+o,o3	o,64	-	-
	7	-	-	y=-o,oo17x+o,o2	o,68
$\frac{In_{1,2,3,\ldots,n}}{Hx_{1,2,3,\ldots,n}}$	o-2	y=-o,o6x+2,51	o,85	-	-
	7	-	-	y=-o,21x+3,1	o,97

On the basis of the results given in Tables 1 and 2, it may be stated that there are close correlations between the Hx index and the duration of storage at 5 °C for pork, and at o-2 °C and at 7 °C for beef; between the index In/Hx and the duration of storage for mixed beef at 7 °C; and between the index 1/Hx and the duration of storage for mixed pork at 5 °C.

To summarize, it may be said that the correlations reported by WENZEL et al., can be extended and applied to the control of the storage time of mixed porks and beefs. We have established that there are close correlations between the three indices and the storage time at a given temperature.

For the prognosis of the quality of meats, we propose the following working procedure:

The amounts of inosine and hypoxanthine in the stored meat are determined in /ug/g at the time of the examination and 24 hours later /WENZEL et al., 1975/. The indices detailed above are obtained. The calculated indices are plotted graphically as a function of the storage time in days. The straight line joining the two points is extended in both directions. The initial values of the indices are obtained from the intercepts on the y axis on days x = o or x = 1. The critical hypoxanthine concentration for mixed pork /i.e. the limit of consumability/ is around 35o ± 25 /ug/g, while that for mixed beef is around 2oo-25 /ug/g. If these limiting values are plotted on the previous graph, and the point of intersection of the two straight lines is projected onto the x axis, we obtain the number of days for which the sample in question can still be consumed. This graphical procedure is suitable for estimation of the prevailing storage time of stored meat with practical accuracy, and for indicating the time when the decomposition of the meat reaches a dangerous level. In the case of known starting indices /Hx_1, $1/Hx_1$, In_1/Hx_1/, e.g. under factory conditions, the accuracy of the procedure can be increased to a great extent through the presented statistical accuracy.

The authors express their grateful thanks to Prof. S. WENZEL, Director of the Institute of Meat Hygiene and Meat Technology, at the Veterinary Science University in Hannover, for his generous and indispensable assistance towards our work.

References:

1/ Terasaki, M., M. Kajikawa, E. Fujita, K. Ishi: Studies on the flavor of meats Part I. Formation and Degradation of Inosinic Acids in Meat. Agr. Biol. Chem. Japan 29, 2o8-215 /1965/

2/ Hamm, R., K. Potthast: Qualitätsabweichungen bei Schweinefleisch. Biochemische Ergebnisse, Fleischwirtschaft 52, 2o6-2o8. /1972/

3/ C. Gissel: Untersuchungen über Vorkommen und Verhalten der Mononukleotide und ihrer Spaltprodukte im Schweinefleisch und ihre Bedeutung als hygienischer Parameter, Inaugural-Dissertation, Hannover, 1972

4/ S. Rerod: Untersuchungen über Vorkimmen und Verhalten der Mononukleotide und ihre Spaltprodukte in Rindfleisch und ihre Bedeutung als hygienischer Parameter. Inaugural-Dissertation, Hannower, 1973

5/ C. Gissel, S. Rerod, S. Wenzel: Untersuchungen über das Vorkommen von Inosin. Hypoxantin und Xantin in gelagertem frischem Rindfleisch. Archiv für Lebensmittelhygiene 26, 2o1-24o, /1975/