Investigation of the effect of transport of animals on the content of ammonia and amide nitrogen in meat.

J. ČERVENKA, J. ŠLEZINGER.

Dept. of Public and Tropical Vet. Med. Veterinary College of Agricul. Univ.
Brno Czechoslovakia

INTRODUCTION

Many authors studied the problem of the effect of transport on post-slaughter meat quality and meat keeping quality. The authors followed the essential criteria important as indicators of the mentioned meat qualities, especially the pH and the glycogen content in meat (Callow, Hökl, Coretti, Bartels, Alterauge, van Logtestjin, Scheper *et al.*).

Most workers found a certain dependance between the degree of fatique in slaughter animals occuring during transportation and the pH value, and glycogen in muscles, respectively. But some authors pointed out that the presented values did not necessarily change even after an excessive strain. Meara, e.g. describes an experiment where cattle were hunted down to stagger for half an hour closely before slaughter and still the pH. ult. remained unchanged.

The same author quotes the experiment of Lawrie, who was keeping the cattle starving for 18 days before slaughter and neither the glycogen reserve nor the pH changed.

In only one experiment, when cattle were driven 150 miles to a station, then carried by train 625 miles and after the arrival to the slaughterhouse were hunted for one and half an hour (without any rest and feeding) and immediately slaughtered, the pH. ult. increased significantly, compared with the control group which was allowed to rest 14 days following the same procedure and slaughtered afterwards.

For the mentioned reason, not only the pH value and glycogen were investigated in this study, but also the content of NH_3 and amide nitrogen which could also serve as one of the possible criteria of the fatique rate in animals before slaughter.

METHODS

Glycogen was determined by calorimetric method according to Krisman, who employed the iodine-potassium-iodide reagent as the indicator.

The pH was measured by a pH-metre in meat homogenate in redestilled water 24 hours after slaughter.

Ammonia was established by titration according to Conway.

Amide nitrogen was determined in acid meat-hydrolysate after neutralization also by titration according to Conway. Amide nitrogen was recalculated to NH_3. The content of glycogen, the NH_3 and amide nitrogen is expressed in mg %.

The samples were collected from M. semitendineus.

As the laboratory was rather remote from the slaughterhouse, the samples intended for the glycogen determination (cca 2 g) were cut off from the complete samples, wrapped in aluminium foils and put into a thermos flask with pieces of solid CO_2. In the laboratory the frozen samples were weighted and poured over with the hydrolyzing solution.

PROCEDURE

Cattle were divided into 6 groups according to the distance from the slaughterhouse, as follows:

1. 0 — 49 km 43 animals
2. 50 — 99 km 24 animals
3. 100 — 199 km 5 animals
4. 200 — 299 km 25 animals
5. 600 — 799 km 27 animals
6. 800 — 899 km 10 animals

After unloading at the slaughterhouse the animals rested 24 hours. All the animals were bulls, with an exception of four heifers in the group 1.

The weight of animals, the average daily temperature of the atmosphere and the average atmospheric pressure were also taken into consideration.

Elaborating statistically the results obtained, the intercorrelations among the following characteristics were calculated:

1. weight
2. temperature in ° C
3. pressure recalculated to 0° C
4. the pH value
5. glycogen in meat
6. NH_3 in mg %
7. amide N recalculated to NH_3 in mg %.

To give a true picture of the distance effect upon the individual characteristics, the significance for each characteristics was figured out by means of the dispersion analysis: the distances of cattle transportation were used as classes.

Seven analyses were thus elaborated, where the distance represented the grouping criteria, i.e. the number of classes m = 6 and the number of investigations in classes being $n_1 = 43$, $n_2 = 24$, $n_3 = 5$, $n_4 = 25$, $n_5 = 27$, $n_6 = 10$.

It is clear there is no use in elaborating the analyses for the characteristics 1, 2 and 3 (weight, air temperature, air pressure) and we do not, therefore, present them.

Due to the small number of investigations $n_3 = 5$ (distance 100—199 km) it is difficult to estimate statistically the relation between this and the other classes.

From the analyses follows that the transport distance has a certain influence on the glycogen content, the pH, the NH_3 and amide nitrogen.

In spite of some deviations in the pH ult. found when transporting up to 200 km, a marked increase in average pH values appears after a longer transportation period as proved by the significant differences in average values found by S—method.

Substantially less evident are the differences in the values of glycogen, even if it is possible to judge from the results obtained that the decrease of the glycogen values in meat depends on the length of transport.

The relation of the NH_3 content in meat after slaughter to the lenght of transport can be evaluated as statistically significant also when ascertaining the significantly different values by means of S—method among the groups of animals transported from 600—800 km. Except the third group with a small number of investigations, a distinct increase in the average NH_3 content after a prolonged transportation is evident.

On the other hand the amide nitrogen rather distinctly decreases with the distance.

Finding out the correlations among the seven given characteristics we realized that the most significant relation is between the pH and amide nitrogen and between the NH_3 and amide nitrogen. Significant correlations were also found between the weight and the content of ammonia, the temperature and the pH, air pressure and the pH, air pressure and the glycogen content, air pressure and the NH_3 content, air pressure and the amide nitrogen, the pH and glycogen and the pH and the NH_3. It is true that in all cases the correlations only approach significance and it is necessary to evaluate them very carefully.

DISCUSSION

From the results obtained it is evident that besides the amount of the pH and glycogen content determination, it might have been possible to use the content of NH_3 and amide nitrogen to measure the extent of stress influencing the animals during transport. It was also found that the degree of transport influence is lower in cattle compared with pigs investigated earlier, especially in the pH values and glycogen.

Determinating the correlations among the individual data, the closest coherence was found between the pH and amide nitrogen and in addition to this finding it was proved that the greater was the content of ammonia, the smaller was the content of amide nitrogen. This finding may be due to the fact that under the influence of a prolonged transport, cattle produced only a stronger susceptibility to the stress factors influencing closely before slaughter. In this way the NH_3 production in muscles slightly rises and the relatively short period between the slaughter preparation and the sample investigation is not sufficient enough for the NH_3 to react with the esters of organic acids.

As mentioned before, the correlations among the other characteristics only approach significance and it is necessary to evaluate them very carefully.

It may be stated that under given conditions neither the weight of animal, the air temperature, nor the atmospheric pressure played a substantial role regarding the stress conditions. However, these factors may infuence the state of animals, but most likely not before they reach the extreme values.

Tab. 1. *Investigation of correlation among individual characteristics.*

variable X	*variable* Y	*coeff. of. correl.*	*significance*	*y = A+BX* *probability*
1	2	0,067291	insignificant	
1	3	0,069962	insignificant	
1	4	0,003980	insignificant	
1	5	0,107452	insignificant	
1	6	−0,302153	significant	0,01
1	7	0,156984	insignificant	
2	3	−0,077676	insignificant	
2	4	0,230992	significant	0,05
2	5	0,024233	insignificant	
2	6	−0,087518	insignificant	
2	7	0,083710	insignificant	
3	4	−0,259243	significant	0,01
3	5	0,229390	significant	0,05
3	6	−0,201054	significant	0,05
3	7	0,259913	significant	0,01
4	5	−0,212474	significant	0,05
4	6	0,312105	significant	0,01
4	7	−0,405806	significant	0,01
5	6	−0,011029	insignificant	
5	7	0,008664	insignificant	
6	7	−0,590871	significant	0,01

X = distance values Y = characteristics.

LITERATURE

Bartels, H.: Der pH-Wert im Fleisch als Indikator für Haltbarkeit und Eignung des Fleisches zur Verarbeitung. »Fleischwirtschaft», 45, 8, 1965.

Hamm, R.: Hydratation und Rigidität des Rindesmuskels. »Z. Lebensm.-Untersuch.u.Forsch.» 109, 2, p. 113, II., 1959.

Handel, Van, E.: Estimation of glycogen in small amounts of tissue. »Anal.Biochem.», 11, 256—265, 1965.

Heever, van den, L. W.: The pH of meat. »J.S.Afric.Vet.Med.Assoc.», 30, 3, 271, 1959.

Huyser, J. H. — Greathead, M. M. — Meara, P. J.: A preliminary report on pH (Hydrogen-Ion Concentration) Testing of meat by the nitrazin yellow Method, with special Refenrence to casualty animals presented for slaughter. »J.S.Afric. Vet.Med.Assoc.», 31, 4, 443, 1960.

Iwańska, W.: Potencjal oksydoredukcyjny w przebiegu poznatkowych dozrjewania oraz peklowania miesa. »Przem.spož.» 18, 2, 112—113, 1964.

Kekič-Simič, N. — Dakič, M.: Medoti za odredivanje stepena zrelosti mesa »Tehn.mesa», 6, 9, 246—266, 1965.

Krisman, C. R.: A method for calorimetric estimation of glycogen with iodine. »Anal.Bioch.», 4,1, 17—23, 1962.

Lean, Mc, W. D.—Kidney, A. J.: The effect of post-mortem pH of bacon sausage and ham quality. = XI th Europ. meeting of meat research workers, Belgrade, 1965.

Logtestjin, van, I. G.: Der postmortale pH-Wert-Verlauf im Fleisch von Schlachttieren. »Fleischwirtschaft», 47, 3, 240—247, 1967.

Passonneau, J. V. — Gatfield, P. D. — Schulz, D. W. et al.: An enzymic method for measurement of glycogene. »Analyt.Bioch.», 19, 2, 315—326, 1967.

Rose, D.: The biochemistry of meat muscle. »Can. Food. Ind.» 3, 3, 47—52, 1963.

Vrchlabský, J.: Vliv přepravy automobilem na nêkteré vlastnosti masa jatečných prasat. »Vet.med.» 13, 2, 127—136, 1968.

Whistler, R.: Glykogennachweis. »Fleischwirtschaft», 16, 3, 225, 1964.

Schauser, W.: Transportmüdigkeit bei Schlachttieren. »Deutsch. Schlacht.-u.Viehhof Ztg.» 56, 2, II, 33—36, 1956.

Scheper, J.: Der Einfluss mittlerer und langerer Transporte auf die Fleischbeschaffenheit beim Schwein. = Jahresbericht der Bundesanstalt für Fleischwirtschaft in Kulmbach, 1946, p. 16—17.

Trumuć, Ž. — Maksimović, B. — Rajić, J. — Vasiljevović, D.: Promene specifične težine mišića svinjskog i govedeg buta u procesu zrenja. »Tehn.mesa», 6, 9, 242, 1965.

Vetterlein, R. — Kidney, A. J.: The effect of some pre-slaughter variables of pH changes postmortem in pork, and the use of pH in predicting meat quality factors. = XIth Europ. meeting of meat research workers, Belgrade, 1965.

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