Einfluss der Betäubung mit elektrischem Strom von Schweinen auf einige biochemische Kennwerte des Fleisches

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Die Verfasser haben Untersuchungen über die Veränderungen Glykogen-, Milchsäure- und Adenosintriphosphatgehaltes und des pH-Wertes im Fleisch durchgeführt, im Hinblick auf die Abhängigkeit von der Charakteristik des elektrischen Stromes bei der Betäubung der Schweine.

Dabei werden die Vorteile der Betäubung durch Anwendung elektrischer Impulse mit spezieller Form, die von einem im Institut für Fleischwirtschaft - Sofia konstruierten Apparat erzeugt werden, dargelegt.

Effect of the electric stunning of pigs on some biochemical indices of meat

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Observations were made on the changes in the contents of glycogen, lactic acid, adenosine triphosphate, and pH in meat depending on current characteristics in the stunning of pigs.

An indication is given of the advantages of stunning by electric impulses of a special form, generated by an apparatus which was constructed in the Institute.

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Influence de l'étourdissement électrique des porcs sur certaines propriétés biochimiques de la viande

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On a observé les changements ayant lieu dans la teneur quantitative en glycogène, en acide lactique, en adénosine triphosphorique et dans la valeur du pH de la viande en fonction des caractéristiques du courant électrique pendant l'étourdissement des porcs. On signale les avantages de l'étourdissement, effectué en impulsions électriques de forme spéciale, données par un appareil, construit à l'Institut de recherches sur la viande à Sofia.

Влияние оглушения свиней электрическим током на некоторые биохимические показатели мяса

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Проведены наблюдения за изменениями в количественном содержании гликогена, молочной кислоты, аденозинтрифосфата и pH мяса в зависимости от характеристики электрического тока при оглушении свиней.

Указаны преимущества оглушения электрическими импульсами специальной формы, генерированными аппаратом, который сконструирован в Институте мясной промышленности в Софии.

Effect of the electric stunning of pigs on some biochemical indices of meat

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The pre-slaughter treatment of animals and especially the method of stunning influence changes in the quality indices of meat. Data are reported (3, 5, 7, 13, 14) on the fact that transportation, pre-slaughter regime, the animals' physiological state before and during stunning, as well as the method of stunning (4, 8, 9, 10, 11, 12) influence the course of biochemical processes in meat and, consequently, its quality characteristics.

The present work aimed at following changes in the basic biochemical indices of meat, depending on the method of stunning.

Experimental

Two methods were used to stun pigs:

(a) the method traditional in this country: electric stunning by 70-90 V, 50 cycles, up to 0,9 A alternating current for 10 to 12 sec.;

(b) a method developed by us: electric impulses of a special form and frequency for 4-6 sec. For this purpose, an apparatus of semiconductor elements has been constructed in the Meat Technology Research Institute in Sofia.

Experimental animals were selected by the analogue method into two groups of 25 each; they were Bulgarian White pigs at the age of 7 months and a body weight of 90-100 kg.

The pre-slaughter preparation of the pigs and also their driving to the stunning box was done carefully and quietly under the same conditions.

The following experimental work was planned: to follow changes in the content of glycogen, lactic acid, adenosine triphosphate, and in the pH value of muscle tissue, 1, 24, and 48 hours post mortem.

Material was taken from m. Longissimus dorsi in the region of the 6-7th intercostal space. Samples were stored during the studies at a temperature of 0 to 2°C, and with a view to the more precise registration of changes in meat at 1 hour post mortem, the necessary number of samples were frozen in liquid nitrogen at -187°C.

Glycogen was determined by V.S. Asatiani's method (2), lactic acid, by the method of Hohorst (6) using Biochemica Test Combination - Boehringer Mannheim GmbH, and adenosine trophosphate, by Adam's method (1) using Boehringer tests. For the determination of pH value, Seibold pH-meter and standard solutions were used. The reliability of the results was determined by Student-Fisher's table, and doubtful results were processed by Barov's method.

Results and Discussion

Observations on the course of glycogenolysis directed at the determination of glycogen level and pH value, are shown in Fig. 1 and 2.

Fig. 1 shows that changes in glycogen level in the meat of pigs stunned by the method of our development, take the course of a curve of the same direction as in the one indicating changes upon stunning by the existing method. The values obtained 1, 24, and 48 hours post mortem, respectively, when using the method developed by us, are higher: 845,0 ± 16,60 mg%, compared to 732,5 ± 17,79 mg%; 195,4 ± 6,72 mg% compared to 149,7 ± 5,24 mg%; and 92,4 ± 2,01 mg% compared to 78,7 ± 2,57 mg%: significant at $P < 0,001$.

The results obtained give us grounds to assume that glycogen degradation has a more favourable course in the meat of pigs stunned by the method of our development. This is supported by the faster onset of rigor mortis observed in the fore limbs of pigs stunned by the traditional method.

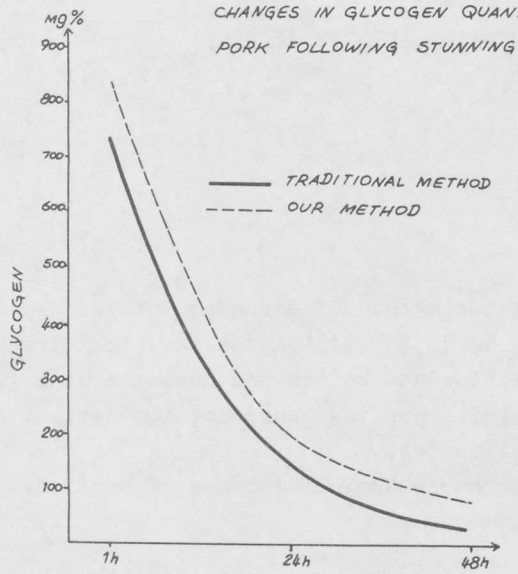

FIG. 1

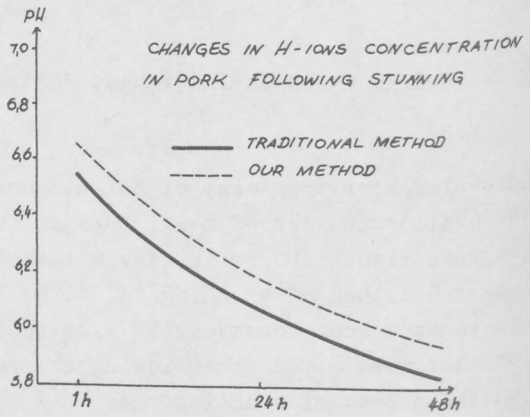

FIG. 2

From the graph in Fig. 2 it becomes obvious that the differences found in pH value on different hours are in favour of the method developed by us. Thus the meat of pigs stunned by the traditional method, has a pH of 6,56 ± 0,02 1 hr. post portem; 6,08 ± 0,03 24 hrs post mortem; and 5,87 ± 0,03 48 hours post mortem, while upon stunning by the method developed by us, the results are 6,66 ± 0,01; 6,19 ± 0,02; and 6,07 ± 0,07, respectively. These differences are significant at $P < 0,001$.

The results presented in Fig. 3, indicate that lactic acid level in the meat of pigs stunned by our method is lower: 421 ± 40 micromols/g compared to 437 ± 10 micromols/g after 1 hour,

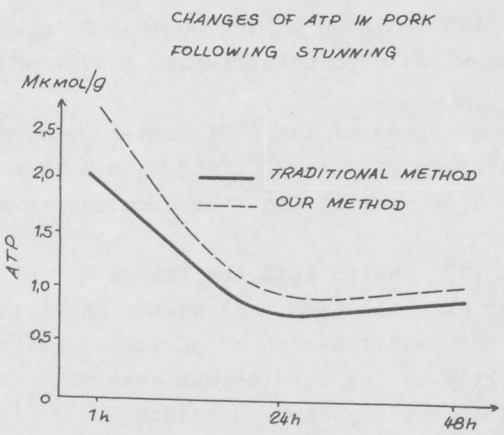

FIG. 4

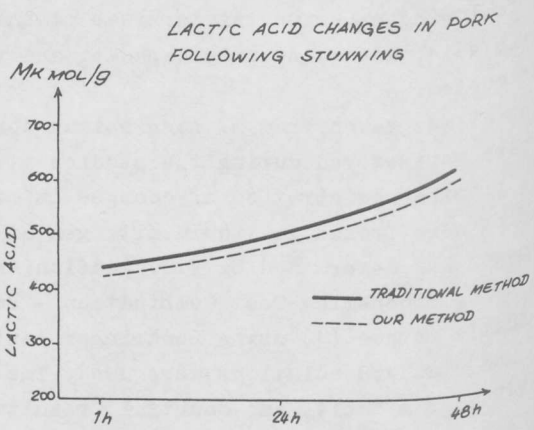

FIG. 3

significant at $P < 0,001$; 478 ± 40 micromols/g against 503 ± 70 micromols/g after 24 h.: significant at $P < 0,01$; and 602 ± 50 micromols/g against 622 ± 60 micromols/g after 48 hours: significant at $P > 0,02$. The results obtained indicate a correlation with the changes found in glycogen content and pH value ($P_t < 0,001$) and confirm the fact that autolytic processes in the meat produced have a more favourable course upon the stunning of pigs by the method developed by us.

Fig. 4 shows that ATP content in micromols/g is higher in the meat of pigs stunned by our method: 2,57 ± 0,09 micromols/g against 1,98 ± 0,03 micromols/g after 1 hour; 0,89 ± 0,03 micromols/g compared to 0,79 ± 0,03 after 24 hours; and 1,11 ± 0,09 micromols/g against 0,99 ± ± 0,02 micromols/g after 48 hours. These are significant at $P < 0,001$; $P > 0,02$, and $P < 0,05$, respectively.

The results obtained on ATP degradation in pork indicate that after 24 hours, ATP level decreases greatly which is due, in our opinion, to the rapid hydrolysis of ATP, with the result of the binding of actine with myosine and the onset of rigor mortis. That was also determined technologically. As far as the observed slight increase in ATP at 48 hours is concerned, it is probably due to the still going anaerobic glycolysis resulting in the accumulation, though in a limited amount, of ATP. The increase in lactic acid that we found is in accordance with the ATP increase mentioned, and we assume the sharp decrease of glycogen (on the 24th hour) to result from glycogen hydrolysis to glucose, which is transformed into lactate, and not pyruvate. The lower ATP values found after 1 hour, upon stunning by the traditional method, suggest a more intensive degradation in vivo, which gives us grounds to assume those changes to be due to certain defects of that method.

Conclusion

The results obtained allow us to draw the conclusion that changes in glycogen, lactic acid and adenosine triphosphate levels and pH of the meat of pigs stunned by the method of our development, using electric impulses of special form and frequency, have a favourable course compared to those upon stunning by the traditional method, using 70-90 V, 50 cycles, up to 0,9 A alternating current.

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