# EFFECT OF THE PRESLAUGHTER REST ON THE CHANGES IN SOME PARAMETERS OF BLOOD AND IN M. LONGISSIMUS DORSI OF PIGS

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## INTRODUCTION

The long-term selection of animals aimed at high meat yield has resulted in obtaining of poor adaptability. Stress factors causing qualititative changes in live pigs are manifested after slaughter as watery /PSE/ or dark /DFD/ muscles [14,20].
The transportation of animals to the slaughter-house can have a particulary deterimental effect on their organism.
The changes which occur in the muscles as the results of stress factors are also found in the blood of animals [3,7]. Variation in the activity of certain enzymes and changes in the proteins and carbohydrates of blood serum are observed.
The aim of this study was to find out which extent the preslaughter rest can reduce the results of transportation stress in the animals.

## MATERIAL AND METHODS

Experiments were carried out on 48 pigs of 100 to 120 kg live weight. One half of them came from commercial pig growing farms, the second half from small agricultural farms. In each of these two groups of pigs there were two sub-groups: sub-group no.1 was slaughtered immediately on arrival to the plant and sub-group no.2 was slaughtered after 16 h rest. The transportation routes from the farms to the slaughter-house have not exceeded 60 km.

The samples of longissimus dorsi muscle between the second and fourth lumbar vertebra excised 35 to 40 minutes post mortem, and blood samples collected during bleed-out were analysed.
The pH in the muscle 45 minutes /$pH_1$/ and 24 hours /$pH_2$/ after slaughter and glycogen and lactic acid content were determined in the same time. Glycogen was determined by the anthrone method [2], and lactic acid by the method of Dische-Laschlo [10]. Glucose content [15], lactic acid content [10] and concentration of hydrogen ions were measured in blood samples.
The activity of AlAt and AspAT, and of the acidic and alkaline phosphatases [13] as well as the kalium and sodium ions content [9] were determined in the blood serum.
Alkali reserve was measured in the blood plasma stabilised with sodium oxalate [17].
The pH of blood was measured immediately after slaughter of pigs, while the other analyses were carried out 2 hours after delivery of the blood serum and plasma to the the laboratory.

## RESULTS AND DISCUSSION

In Table 1 mean values of the examined characteristics of the longissimus dorsi muscles are presented. Lower pH values were found in the muscles of pigs grown in small agricultural farms. The number of animals which showed muscle $pH_1 < 6.0$ /regarded as PSE/ was 16.5%, when the pigs were slaughtered just after transport, and 25% when slaughtered after 16 hours rest.
The pigs which came from commercial growing farms and were slaughterd immediately on delivery to the processing plant demostrated 25% PSE muscles i.e. of $pH_1 < 6.0$, and 9.25% partially watery muscles of $pH_1 = 6.0-6.3$ [8]. After a 16 hours rest, the

Table 1
pH value, glycogen and lactic acid content in m. longissimus dorsi

| Character-teristic | Small farms | | Commer. farms | |
|---|---|---|---|---|
| | 0* | 16* | 0 | 16 |
| $pH_1$ | 6.32 | 6.20 | 6.39 | 6.62 |
| $pH_2$ | 5.60 | 5.67 | 5.61 | 5.84 |
| Glycogen mg/100g | 890 | 996 | 996 | 763 |
| Lactic acid mg/100g | 180 | 183 | 221 | 139 |

*-duration of preslaughter rest in hours

number of carcasses showing partially watery muscles increased to 25% and the percentage of DFD type muscles was at the same level.
This finding might indicate that the 16 h rest prior to slaughter had a detrimental effect on the animals. It was found that muscles from pigs grown in the commercial farms demonstrated quality defects more frequently, regardless of the duration of the preslaughter rest.
The pH value of blood collected during slaughter varied greatly from 7.20 to 7.65 higher values were observed in pigs slaughtered after 16 hours rest both in the animals from commercial farms and from small agricultural farms.
Glycogen content in the normal muscle tissue, measured immediately after slaughter /Tab.1/ was always higher then in the PSE and DFD muscles. This finding has confirmed the results of previous studies of other authors [3,6,12].
In the muscle tissue of pigs grown in small agricultural farms and slaughtered after 16 h rest a higher mean glycogen content was found than in pigs of the same group but slaughter immediately after transport /Tab.1/. This might suggest certain regeneration of glycogen in the muscle. In the group of pigs from commercial farms a reverse situation was observed. In the animals slaughtered after 16 h rest, muscles of DFD type occured and a higher number of animals demonstrated PSE muscles.
This might indicate a higher susceptibility to stress of pigs grown in commercial farms, as it was also observed by Topel [19] and Ono and Topel [12],who found a higher glycogen content in the pigs susceptible to stress. The authors attributed this finding to the increased mobilisation of the animal organism in the changeable environmental conditions.
No clear differences were observed between the lactic acid content and both the duration of preslaughter rest of pigs and the growing system of the experimental animals. A low content of the lactic acid was found only in the group of pigs in which the DFD type of muscle was noticed . This finding demonstrated low storage life and poor quality of DFD meat in respect to futher processing and cooking [14].
The biochemical changes observed in the muscles were partially reflected in the blood characteristics. Glucose content in the blood of pigs from commercial farms was found higher than in the blood of animals grown in small agricultural farms /Tab.2/.
In both cases the glucose content was always higher in pigs slaughtered immediately after transport. Kallweit and co-workers [5] and Kluczek [7] observed also an increase of the glucose content in the vene-blood of animals being under stress conditions. This hyperglycaemia dissapeared after the rest of the animals. The increase of the glucose content in blood may be

Table 2
pH value and amounts of some products of glycogenolytic process in the blood of animals

| Characteristic | Small farms | | Commer. farms | |
|---|---|---|---|---|
| | 0* | 16* | 0 | 16 |
| pH | 7.35 | 7.40 | 7.34 | 7.43 |
| Glucose mg/100g | 76.3 | 65.5 | 86.6 | 76.9 |
| Lactic acid mg/100g | 42.5 | 32.8 | 41.6 | 30.6 |

*-duration of preslaughter rest in hours

attributed to the glycolytic activity of adrenalin. Its increased secretion is observed under stress conditions.
The content of the lactic acid in the blood was found higher in pigs slughtered immediately after transport. Its higher content resulted, presumally, from the fatigue of animals as reported in other studies [3,5,7]. A higher lactic acid content in the blood than in the muscles of pigs grown in small agricultural farms might indicate a slower glycolytic rate as compared with that in the muscles of pigs delivered from commercial farms. A slow glycolysis rate is typical for stress-resistant animals [6].
The activity of examined enzymes is presented in Table 3. Two of them, i.e. AlAT and AspAT are present in cell cytoplasm. The damage of cellular mambranes can result in the transfer of enzymes to the tissue fluid and blood [8]. Homolka [4] attributed the increased activity of serum amino-tranferases to the changes in the selective permeability of cellular membranes.
The experimental findings demonstrated an increased activity of blood AlAT and AspAT in all the examined pigs, slaughtered

Table 3
The activity of some enzymes in the blood plasma of investigated pigs

| Characteristic | Small farms | | Commer. farms | |
|---|---|---|---|---|
| | 0* | 16* | 0 | 16 |
| Acid phosphatase B.U.** | 2.01 | 2.59 | 2.75 | 2.87 |
| Alkaline phosphatase B.U. | 2.52 | 2.39 | 5.87 | 2.50 |
| AlAT U/ml | 57.1 | 41.4 | 30.0 | 13.0 |
| AspAT U/ml | 67.3 | 64.1 | 57.8 | 13.9 |

*-duration of preslaughter rest in hours
**- Bodański's unit

immediately on delivery to the slaughter-house.
Activity level of both enzymes specified above was higher in pigs demonstrating watery muscles after slaughter, compared to enzyme activity level found in the blood of pigs in which the muscles were of normal quality.
A decreased activity of aminotransferases was found in pigs which showed the DFD type of muscle. These findings confirm the results of an earlier study by Kluczek [7].
In the case of phosphatases, their higher activity was determined in the blood of pigs which had been grown in commercial farms. The average activity of the acid phosphatase was always higher after 16 h rest. On the other hand the activity of the alakaline phosphatase, related to the permeability of cellular membranes, was always higher in pigs slaughtered immediately after transport.
The acid phosphatase, as one of the main lysosomal enzymes, demonterated slight changes of ac-

tivity. The decreased content of acid phosphatase in the blood of pigs, slaughtered immediately after transport resulted presumably from the eleveted secretion of corticosteroids which lowered its activity. A higher secretion of these hormones has been found in stress-susceptible animals [16]. A sligtly higher phosphatase activity in the blood of pigs from breeding farms might indicate, similary as it is in the case of aminotransferases, to the lack of equilibrium in the permeability of the cellular membrane [18].

In Tab.4 the quantities of K and Na ions in the blood of pigs are presented. The content of these ions was found higher in the blood serum of pigs slaughtered immediately after transporation, particularly those from commercial farms.

Table 4
Content of $K^+$ and $Na^+$ ions in the blood plasma of investigated pigs

| Character-teristic | Small farms | | Commer. farms | |
|---|---|---|---|---|
| | 0* | 16* | 0 | 16 |
| Potassium mEq/l | 6.99 | 6.67 | 7.58 | 5.19 |
| Sodium mEq/l | 176 | 174 | 205 | 168 |

*-duration of preslaughter rest in hours

Moreover, in the both groups of pigs the blood serum contained more K ions than Na ions when the animals were slaughtered immediately after transport. This finding might point to changes in the permability of the cellular membranes, being always associated with an increased migration of potassium into the intercellular space.

This phenomena is always observed in pigs being subjected to stress factors [1].

It can be seen in Tab.5 that the

Table 5
The level of alkaline reserve in the blood plasma of investigated pigs

| Character-teristic | Small farms | | Commer. farms | |
|---|---|---|---|---|
| | 0* | 16* | 0 | 16 |
| % vol. $CO_2$ | 45.3 | 61.3 | 59.2 | 64.7 |

*-duration of preslaughter rest in hours

lowest level of blood alkaline reserve was found in pigs slaughtered immediately after transport. The highest differences in the alkali reserve level, as influenced by the duration of preslaugter rest, were found in pigs grown in small agricultural farms. These relationships are in line with the experimental results concerning blood pH value and lactic acid content /Tab.2/. The dicarbonate level was inversly proportional to the glycogenolysis rate, and this finding was repoted also by other authors [7,11,20].

In pigs which produced normal meat the values of the alkali reserve were obtained lower than in pigs demonstranting PSE muscles.

## CONCLUSIONS

Preslaughter rest of pigs in the processing plant had no effect on decreasing the stress symptoms ante-mortem. Muscles of poor quality /PSE and DFD/ were noticed both in pigs slaughtered immediately after transport as well as in those which were given 16 h rest prior to slaughter.

Pigs delivered from small agricultural farms demonstrated a slower glycogenolysis rate, while those delivered from commercial growing farms were more susceptible to stress.

The fatigue of animals resulted in an increased permeability of cellular membranes, and a higher activity of AlAT and AspAT transaminases and of alkaline phosphatase was found as well as an elevated migration of potassium ions from the cells.

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