

INVESTIGATIONS ON THE INFLUENCE OF TRANSPORT UPON THE APPEARANCE,
RUN AND CEASING OF STRESS REACTION IN CALVES AND PIGS AND ITS
IMPACT ON THE TECHNOLOGICAL QUALITIES OF MEAT

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The transport of ruminants and pigs from the place they are reared to the slaughter house, the length of the preslaughter rest, means of stunning, degree of deblooding of the carcass and others, all have a significant influence on the contents, taste qualities and storage of meat. It has been decided and proved that fatigue and muscle tension in animals before slaughter induce a decrease in the glycogen (20,22,24) and increase the mean values for pH of the muscles (9,13).

During the preslaughter rest, the quantity of the glycogen in the muscles gradually increases (9,20,22,24). There is no unified opinion for the necessity of the preslaughter rest and its impact for the normalisation of the changes induced under transport conditions (9,13,24).

Prolonged transport is tolerated in a worse manner by pigs, than from calves and the rest of domestic animals (9); In this respect especially sensitive are some breeds of pigs - "stress receptive" (SRp) with which, differently from "stress resistant" (SRs) pigs, the quantity of glycogen in the muscles, after the transport normalises for comparatively longer time, and the meat after slaughter exhibits bad technological qualities (18). In the so called stress receptive pigs, during transport and shortly afterwards, have been observed death cases (15).

The character of the stress reaction in the animals, the significance of the preslaughter rest, and the time necessary for restoring the changes observed after transport have been investigated very little (10,11,19,21,22,23).

Our investigations have for object to study the influence of automobile transport on the run of stress reaction in calves and pigs. For this reason the dynamics of such physiological indices was studied, which characterise stress condition of the organism and metabolism during the transport, preslaughter rest and some time after slaughter. Some technological qualities of meat were also studied.

Material and Methodics

The studies were made on 27 calves aged 8 and 11 months and having a live weight of 250-450 kg and on 55 pigs having a live weight of 80-110 kg. The calves were transported by trucks on 0,130,175,260,350,

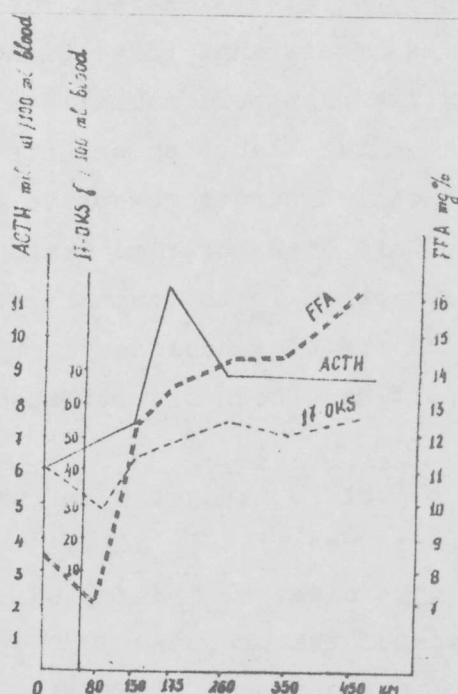
and 450 km, and the pigs on 80, 150, and 200 km upon lightly hilly terrain with mean speed for the transport of 45 km/h, with air temperature in the chamber 18-26°C.

Immediately before beginning of the transport was taken blood from the ear vein or the jugular vein, and muscle by biopsy. After the transport during the preslaughter rest, samples were taken from the calves on the 7, 10, 12, 15, and 18th hour, and from the pigs on the 4, 6, 9, and 12th hour. With the pigs was studied the influence of the electric stunning and deblooding of the carcass on the changes in the quantity of muscle glycogen, by sampling on the 15, 30, 45, and 60th m. and on the 4, 12, 14, and 24th hour.

For the appearance, run and cease of the stress reaction was judged by the changes in the total quantity of adreno-corticotropic hormon ACTH (3), corticosteroids - 17 OKS (6) and the free fatty acids FFA (14) in the blood, the changes in quantities of liver and muscle glycogen (16) pH of meat (1), lactic acid in muscles (2); total quantity of serum proteins (17), protein fractions of blood serum and of muscle proteins (4) and changes in the transaminase activity.

Results and Discussion

From the analyses of the obtained data (fig.1) is established



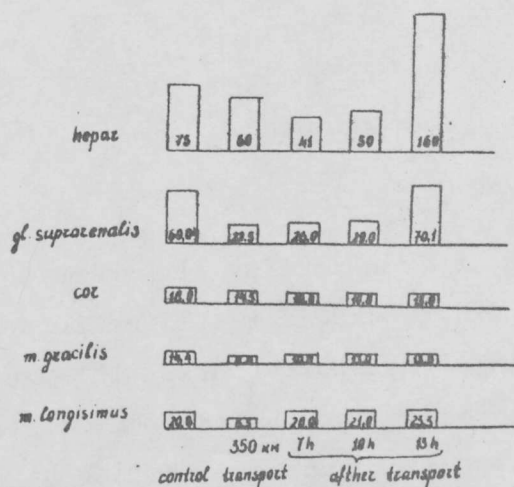
an increase in ACTH in the blood of calves during the transport. The quantity of the ACTH begins to increase on 130 km and reaches highest mean values on 175 km from the start of the transport. After negligible fluctuations, towards the end of the transport (350 - 450 km), ACTH in the blood gradually decreases and returns to normal only 16-20 hours after the end of the transport. Analogical data were received for 17-OKS.

An increase of free fatty acids was determined in the blood of the transported animals, well expressed between 175 and 450th km from the start of the transport. During the preslaughter rest the FFA gradually turn to normal.

The character and run of the stress reaction in the transported animals is exhibited by the dynamics of 17-OKS and the sharp increase of FFA in the strat of the transport (reaction of the catecholamines). It is known that the stimulation of the sympathetic nerve system in the beginning of the stress reaction and the release of adrenalin, might be expressed as fat mobilising effect only on the background of the action of hormones from the cortex of the above kidneys glands, and first of all of the glucocorticoides (5). The dynamics of the ACTH and 17-OKS during the transport, shows, that in ruminants, with the activation of the adrenocorticotropic function of the front part of the hypophyses and the increase of the level of ACTH in the blood is helped the function of the cortex of the above kidneys glands.

Parallel with the variations of the ACTH, 17-OKS and FFA was studied also the content of glycogen in the muscles, the pH, the waterretaining property and the colour of meat. The obtained data show that the content of glycogen in the muscles begin to decrease on 175 km from the start of the transport; which is expressed in the highest degree on the 350th km. During the preslaughter rest, the content of glycogen in the muscles gradually increases, while in certain cases after 12 to 16 hours rest even surpasses the initial quantities. Analogical are the fluctuations of glycogen in the liver, heart and suprarenal glands (fig.2)(table 1).

Fig. 2

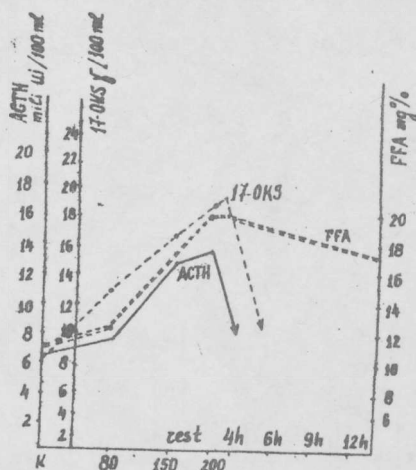


It can be supposed, that the increase of the glycogen formation during the preslaughter rest appears as a consequence of the forced glycogenesis of the organism. It is necessary to note, that the level of 17-OKS during the rest (16-18 hrs) is still high, when the content of glycogen in the muscles attains and even surpasses the initial quantities.

pH in the muscles of the transported calves is higher (6,92-7,05) in comparison to the controls (6,42-6,48). A correlation is established between the length of the transport and pH of the muscles. During the preslaughter rest the mean values for pH gradually decrease. The percent decrease of pH in the muscles, measured some time after the slaughter of the animals, is smaller with the transported than with the not transported animals. This shows, that under the influence of the transport stress, the process of the glycogenolyses in meat, after a rest of 24-48 hrs is violated (7,8,12).

The obtained data for the changes of the colour of the meat and the waterretaining capacity are analogical with the results of other investigators (12,25,26). The meat from transported calves has a higher waterretaining capacity and darker colour in comparison with the meat from not transported animals and those transported to shorter distances (80 km) (table 2).

As with the calves, the quantity of ACTH, 17-OKS and FFA in the blood of the transported animals-pigs increase in relation to the length of the transport (fig.3).



Highest values are established in transporting the animals during 5 hours (200 km). The quantity of ACTH and 17-OKS in the blood turns to the initial norm in 4-6 hours, after the end of the transport. During the preslaughter rest FFA show a tendency to decrease, but in the frame of the investigated period (12 h preslaughter rest) their quantity remains higher from the initial norm. Most probably this could be explained with the increased FFA from the fat deposits during the hunger.

The fluctuations of glycogen in the muscles during transport and the preslaughter rest are given in table 3. From the table it is seen, that after the transport (80,150, and 200 km), the values for glycogen in the muscles decrease. During the preslaughter rest the values of the muscle glycogen gradually increase, reaching the initial values after 5-9 hours of rest. By all probability this could be explained with a strengthened glycogenesis, for which speak the augmented activity of transaminases (GOT and GPT) in the organism (table 4).

During the stunning of the animals and deblooding of the carcass are observed additional increases of the values of the muscle glycogen, related by all probability to a strengthened lyses of the glycogen in the liver. (16). This is confirmed also from the results for the activity of glucoso-6-phosphatase, which during the stunning procedures increases significantly.

During the transport are observed insignificant changes for the values of the serum proteins, which do not surpass the physiological norms for the separate protein fractions. With electrophoretic division of the muscle proteins, it is seen, that the main quantity of the proteins is saturated in the region which relates to beta and gamma-globuline fractions of the pig blood serum. Here are observed six massive fractions, which almost keep their values during the ageing of meat.

Table 1.

Changes in the quantity of muscle glycogen of the transported animals to different distance and different temperature of the transport

Length of transport	Temp. C°	Glycogen-biopsy in mg/100 g muscle tissue		Glycogen -biopsy during preslaughter rest in hrs.				Glycogen-biopsy	
		Before transport	After transport	2	4	6	9	During stunning	Immediately after slaughter
80	18	27,1 + 0,53	18,6 + 0,13	-	-	-	-	-	-
150	18	27,1 + 0,53	13,3 + 0,11	14,0	13,2	15,0	21,3	24,0	26,2
200	26	27,1 + 0,53	12,2 + 0,09	11,3	12,5	13,5	19,0	20,0	24,2

Table 2.

Changes in the waterretaining properties and pH of meat in transport of calves to 80,350, and 450 km.

Length of transport	Water retaining capacity	pH of meat after slaughter in m%		
		2 hrs	24 hrs	48 hrs
80 controls	24,96	6,44 100	6,24 97	5,85 90 ⁸
350	29,5	7,03 100	6,85 97 ³	6,63 94 ²

Table 3.

Changes in the values for muscle glycogen of pigs slaughtered in the shed and transported to a distance of 200 km, with different preslaughter rest

Animals	Values of glycogen		Values for glycogen during ageing of meat							
	Preslaughter bio psy	During stunning	During the first hour after slaughter				During 24 hours			
			15	30	45	60m	4	12	14	24h
Pigs slaughtered on place	37,1 + 0,53	17,0	10,7	12,7	19,2	28,0	29,0	55,0	27,0	52,0
Pigs slaughtered immediately after 200 km transport	27,1 + 0,53	15,0	45,0	60,0	45,0	28,0	15,0	3,0	-	-
Pigs transported 200 km and rested for 6 h before slaughter	47,0	39,5	24,5	20,0	9,0	17,5	14,0	23,0	-	27,0
Pigs transported 200 km and rested for 9 h before slaughter	68,0	46,0	31,5	18,5	35,0	27,5	25,0	27,0	27,0	35,6

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