

THE STRESS SYNDROME AND MEAT QUALITY

SESSION C: MUSCLE BIOCHEMISTRY

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The papers in this Session deal with aspects of muscle biochemistry in relation to the properties of meat. The communications cover four species, the pig, the ox, the Boer goat and the horse. One report (Bailey and Kim, p 35) is concerned with the degradation of muscle proteins by lysosomal proteinases while the remaining three deal essentially with ATP and post-mortem glycolysis in skeletal muscle. The papers by Heffron, Dreyer and Naude (p.40) and Mothersill and McLoughlin (p.43) provide a very interesting comparative study of post-mortem changes in striated muscles of two ruminant species. Fortunately, both groups of authors have used the same muscles (M. psoas major and M. longissimus), the methods of stunning and slaughter, analytical procedures as well as the same conditions of rigor onset (37°C under nitrogen) in their investigations. The results can therefore be compared with a considerable degree of confidence.

In both the ox and the Boer goat, stunning and slaughter appear to cause a greater fall in pH and in C P content of M. psoas major than of M. longissimus dorsi. In fact, the values presented in these papers for these two parameters are remarkably similar for each anatomical muscle, irrespective of species (Table 1). The rate

TABLE 1

POST-MORTEM VALUES FOR OX AND BOER GOAT

Muscle	Initial pH		C P	
	<u>ox</u>	<u>goat</u>	<u>ox</u>	<u>goat</u>
M. psoas major	6.52	6.59	2.3	2.6
M. longissimus dorsi	6.84	6.84	7.2	7.4

TABLE 2

ATP IN OX AND BOER GOAT MUSCLE (u mole/gm)

Muscle	Ox	Goat
M. psoas major	4.4	8.4
M. longissimus dorsi	5.6	6.3

of pH fall appeared to be higher in M. psoas major than in M. longissimus dorsi (see pH/time curves in texts).

The initial ATP content of M. psoas major was lower than that of M. longissimus dorsi in both species, although the concentration of this high-energy phosphate was in each instance greater in the goat muscle than in the corresponding muscle of the ox (Table 2).

Heffron et al. also provide data on pH, C P and ATP for

muscles removed under halothane/nitrous oxide anaesthesia from Boer goats. Comparable data are not available for the ox but comparisons can be drawn between the values for goat muscle and those recently published for muscle removed from Irish Landrace pigs using the same anaesthetic procedure. The C P value (16 $\mu\text{mol/g}$) for Boer goat M. semitendinosus removed in vivo is similar to that found by Tarrant et al (1972)* in the predominantly red fibre area of pig M. semitendinosus although appreciable lower than that in the predominantly white fibre area of this muscle. In the pig, the level of ATP in red M. semitendinosus in vivo was 4.9 $\mu\text{mol/g}$, a value appreciably lower than that in goat M. semitendinosus (8.7 $\mu\text{mol/g}$). Muscle from unaesthetised Landrace also exhibited a slow rate of glycolysis at 37°C under nitrogen. However, after stunning and exsanguination the skeletal musculature of pigs was characterised by a greater burst of glycolysis compared with the muscle of the ox or goat. In the pig muscle the initial pH (M. longissimus dorsi, M. semitendinosus) was depressed to 6.3, and the initial concentration of C P was virtually depleted (2.0 $\mu\text{mol/g}$).

The slow rates of pH fall observed in ox muscle by Mothersill and McLoughlin were confirmed by the lactate concentrations in the tissue at the various time intervals shown in the lactate/time curves. The glycogen contents of the muscles were also confirmatory, the glycogen level in M. psoas (7.9 mg/g) being significantly less than that of M. longissimus dorsi (10.4 mg/g).

Mothersill and McLoughlin investigated the rate at which MgATP^{2-} was split by natural actomyosin in relation to differences

*Tarrant, P.J.V. Hegarty, P.V.J. and McLoughlin, J.V. Proc. Roy. Ir. Acad., 72 B, (229-251).

in rate of ATP loss and postmortem glycolysis between the two ox muscles. The results suggested that preparations made from M. psoas had a somewhat higher hydrolytic activity than those from M. longissimus dorsi. If these results are correct, then they would imply that the ATPase activity of the contractile proteins was adaptive to function. Indeed, differences in the activity of preparations of myosin from different species and different muscles suggest that myosin may be functionally adaptive. On the other hand, the very low levels of C P (c 2.0 $\mu\text{mol/g}$) in M. psoas muscle might be sufficient to account for the rather more rapid disappearance of ATP from this muscle since the rate of ATP loss accelerates considerably when the concentration of C P in muscle falls below about 4.0 $\mu\text{mol/g}$.

The authors of the paper 'The ATPase activity of myosin and ATP yield as affected with a depolarising myorelaxant brothyline' (Bortkevitch and Krylova) describe the effects of administration of a muscle relaxant on the ATP content of equine muscle. The results showed that increasing doses of brothyline (a di-bromo derivative of succinylcholine) progressively raised the concentrations of ATP found in the musculature post mortem. This result is not unexpected since the use of other muscle relaxants, e.g., the non-depolarising drug curare and myanesine which acts on the motor neurons of the anterior horns of the grey matter in the spinal cord, raise the levels of ATP in pig muscle. However, the paper contains the interesting information that the myorelaxant reduces the activity of the myosin ATPase in vitro. This observation suggests a possible site of action other than the post-synaptic membrane of the neuromuscular junction for brothyline. In this context it might be noted that Mothersill and McLoughlin (unpublished) recently found that the neurotransmitter

serotonin inhibited the splitting of $MgATP^{2-}$ by natural actomyosin in vitro.

The paper by Bailey and Kim might be read in a more suitable context if placed in Session P since it deals with factors i.e. lysosomal enzymes from the white cells of residual blood present in muscle post mortem, not previously investigated in relation to the tenderisation of meat. However, the relevance to the stress syndrome of this paper is the possibility that lysosomal proteinases may be released not merely post mortem or following tissue damages but as a response to more generalised stress.