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THE STRESS SYNDROME AND MEAT QUALITY

ABSTRACT

ENGLISH

MORPHOLOGY OF MUSCLE FIBRES FROM PIGS ANAESTHETISED WITH HALOTHANE

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Individual fibres separated from the red and white areas of m. semitendinosus of Pietrain and Landrace pigs were examined by light microscopy. Muscle specimens taken from live Pietrain pigs under halothane anasethesia showed considerable disruption of the typical organised structure of the fibres; specimens taken when the muscle had gone into rigor attached to the skeleton were normal in appearance. Corresponding specimens from muscle of Landrace pigs which had received halothane contained normal fibres. Fibres in specimens taken immediately post-mortem from untreated Pietrain pigs were mostly normal in appearance. The results suggested that fibres in the live Pietrain pigs were normal and that distortion resulted from a hypersensitivity to stimuli induced by halothane. The average diameter of fibres in the red and white areas of Pietrain muscle in rigor were not different although in the Landrace the diameter of white fibres was greater than that of red.

MORPHOLOGIE DES FIBRES MUSCULAIRES DE PORCS ANESTHESIES A L'HALOTHANE

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Des fibres individuelles séparées des zônes rouges et blanches de M. Semitendinosus de porcs Pietrain et Landrace ont été examinées au microscope optique. Les specimens de muscles prélevés sur des porcs Pietrain vivants sous anasthésie à l'halothane ont montré une dislocation considérable de la structure organisée typique des fibres; des specimens prélevés quand le muscle était entré en rigor attachés au squelette étaient d'apparence normale. Les specimens correspondants du muscle de porcs Landrace ayant reçu de l'halothane contenaient des fibres normales. Les résultats ont suggéré que les fibres examinées sur les porcs Pietrain vivants étaient normales et que la dislocation résultait d'une hypersensitivite aux incitations motrices provoquees par l'halothane. Les diamètres moyens des fibres dans les zônes rouges et blanches du muscle Pietrain in rigor n'étaient pas différents plus grand que celui des rouges.

MORPHOLOGIE DER MUSKEL FIBERN VON MIT HALOTHANE BETÄUBTEN SCHWEINEN

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Individuelle Fibern, getrennt von roten und weissen Gebieten von M. Semitendinosus von Pietrain und Landrace Schweinen wurden bei Lichtmikroskopie untersucht. Von lebenden Pietrain Schweinen unter halothane Anasthesie entnommene Muskelproben zeigten wesentliche Zersetzungen der organisierten Fiberstruktur; entnommene Proben, wenn der in der Totenstarre befindliche Muskel noch mit dem Skelett verbunden war, waren normal in Erscheinung. Entsprechende Muskelproben von Landrace Schweinen, welche halothane empfangen hatten, enthielten normale Fibern. Sofort nach dem Tode entnommene Fiberproben von unbehandelten Pietrain Schweinen waren meistens normal in Erscheinung. Die Resultate deuteten an, dass Fibern in lebenden Pietrain Schweinen normal waren und die Verzerrung von einer Überempfindlichkeit gegen Stimulation durch halothane herrührte. Der durchschnittliche Durchmesser von Fibern in den roten und weissen Zonen von Pietrain Muskeln in Totenstarre waren nicht verschieden, obgleich in der Landrace Rasse der Durchmesser von weissen Fibern grösser war als in den roten.

МОРФОЛОГИЯ МЫШЕЧНЫХ ВОЛОКОН ИЗ СВИНЕЙ, ОБЕЗБОЛИВАННЫХ ГАЛОТАНОМ

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Отдельные волокна, выделенные из красного и белого районов **M.semitendinosus** свиней пород Пьэтрен и Ландрас, исследовались светомикроскопией. Пробы, взятые из живых свиней породы Пьэтрен, обезболиванных галотаном, показали значительное разрушение характерной организованной структуры волокон, а пробы взятые при наступлении **rigor** оказались нормальными. Соответсвующие пробы из мышец свиней породы Ландрас с галитаном содержали нормальные волокна. Волокна в пробах, взятых сразу после убоя из необработанных свиней, породы Пьэтрен оказались нормальными, большею частью.

Полученные результаты показывают, что волокна в живых свиньях Пьэтрен нормальны, и что искажение происходит из-за гиперчувствительности к вызванным галотаном стимулам. Средний диаметр волокон в красных и белых районах мышец Пьэтрен **in rigor** не отличались друг от друга, но у Ландрас диаметр белых волокон превышал красных.

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The anaesthetic halothane is known to cause malignant hyperpyrexia and muscular rigidity in stress-susceptible breeds of pig (Wilson et al., I966; Harrison et al., I968; Berman et al., I970; Woolf et al., I970; Berman and Kench I97I; McLoughlin and Mothersill, I974). Harrison et al., (I968) reported the presence of atypical fibres in the musculature of pigs which had suffered malignant hyperpyrexia. Muir (I970) found many distorted fibres in muscle taken from Pietrain pigs at I5 min. post-mortem. In the work reported here, individual fibres were separated from the red and white areas of m. semitendinosus of Landrace and Pietrain pigs and examined by light microscopy. Specimens of muscle were taken from live animals under halothane anaesthesia and again when the muscle had gone into rigor mortis. Specimens were also taken from pre-rigor and rigor muscle of normally slaughtered pigs.

MATERIALS

Samples of tissue were taken from the predominantly red and white fibres areas of m. semitendinosus from purebred Pietrain (I8) and Landrace (4) pigs and individual fibres separated and examined by light microscopy.

The animals were divided into three groups:-

(a) Pietrain (6) and Landrace (4) pigs anaesthetised with halothane and nitrous oxide. Specimens were taken from muscle in vivo. The animals were exsanguinated and further specimens taken when the muscle had gone into rigor (6 hr.) while attached to the skelton.

(b) Pietrain pigs (6) exsanguinated without stunning.

(c) Pietrain pigs (6) stunned using a captive bolt and exsanguinated.

Pre-rigor muscle was taken (ca IO min post-mortem) from groups (b) and (c).

METHODS:

Samples (IO) of tissue (25 to 40)mg.) were removed from the red and white areas of m. semitendinosus and placed in Ringers solution (2 ml., pH 7.I). The solution contained E.G.T.A. at a concentration (IO mM) which prevented the contraction of pre-rigor muscle (Hegarty and Naude, I970). The samples were separated into individual fibres by homogenisation at low speed in a polytron homogeniser. A drop of the homogenate was placed in the well of a microscope slide, covered with a cover slip and examined under the light microscope.

RESULTS AND DISCUSSIONS:

Fibres separated from muscle specimens taken from the Pietrain pigs under anaesthesia presented a grossly-distorted appearance under the light microscope (Fig.I, 2, 3). Cross striations were absent and the membranes of the fibres were folded and corrugated. Many fibres contained irregular dark bands which resembled the contraction bands described by Cassens et al. (I963) in pre-rigor muscle or the bands of precipitated protein reported by Bendall and Wismer-Pedersen (I962) and McLoughlin and Goldspink (I963) in post-rigor muscle. The fibres resembled those found in muscle which had been subjected to thaw rigor and which had supercontracted (Luyet, I966).

The fibres separated from rigor muscle of the same animals were normal (typical fibres are shown in Fig.4). This observation indicated that the appearance of specimens taken from the live animal was not due to gross structural abnormalities present in vivo and suggested that it might have been due rather to severe contraction of the fibres during excision. Fibres taken from live Landrace pigs anaesthetised with halothane were normal in appearance. Pre-rigor fibres separated from Pietrain muscle at IO min. after slaughter by exsanguination were normal. Abnormal fibres were found in muscle of two Pietrains which were stunned with a captive bolt prior to exsanguination; muscle from four other animals slaughtered in this way, contained normal fibres. Muir (I970) reported the presence of distorted fibres which lacked cross-striations in muscle taken at I5 min. post-mortem from Pietrain pigs were stunned with a captive bolt.

It was not possible to measure the diameter of fibres taken from the live Pietrain pigs because of the degree of distortion. The average diameter of the rigor fibres from the red (9Iμm) and white(75μm) areas of the muscle were not significantly different; neither were the sarcomere lengths (red 2.49 μm, white 2.32 μm). The diameters of red and white fibres were not significantly different in either pre-rigor or rigor muscle from the Pietrains which were exsanguinated. The reduction in fibre diameter when the muscle went into rigor was highly significant ($P<0.001$). The average diameter of the red fibres decreased from I27 to 90μm that of the white from I07 to 72μm. In both groups of pigs, the average diameter of the red fibres was numerically greater than that of the white. Earlier work on the Irish Landrace pig (Tarrant, Hegarty and McLoughlin, I972) showed that the average diameter of red fibres (75μm) was significantly less that that of the white (82μm) in this breed.

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Fig. I. Typical fibre removed in vivo from Pietrain pigs anaesthetised with halothane.

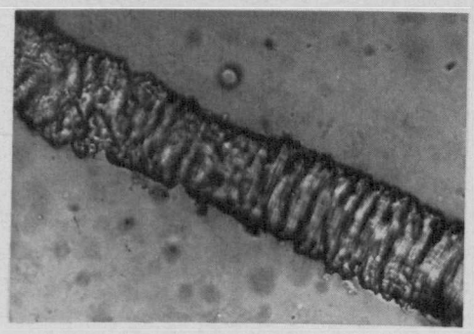

Fig. 2. Typical fibre removed in vivo from Pietrain pigs anaesthetised with halothane.

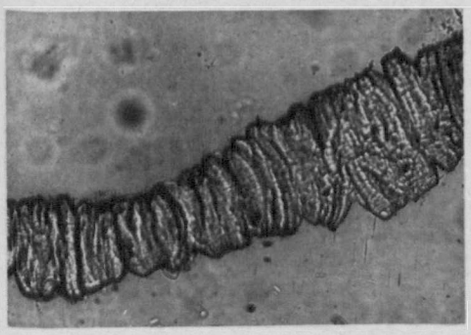

Fig. 3. Typical fibre removed in vivo from Pietrain pigs anaesthetised with halothane.

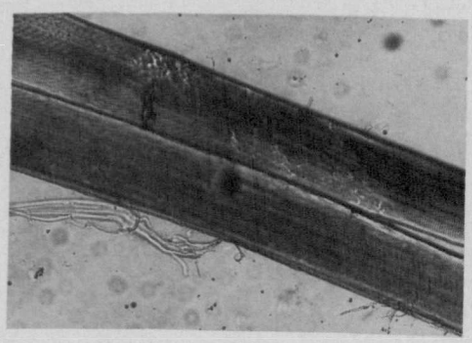

Fig. 4. Typical fibres removed post-mortem (6 hr.) from Pietrain pigs anaesthetised with halothane. The muscle went into rigor attached to the skeleton.