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EFFECT OF THE ADDITION OF CORN OIL AND α-TOCOPHEROL ACETATE IN FEED ON THE HISTOCHEMICAL PROFILE OF *M. LONGISSIMUS LUMBORUM* OF FATTENERS*

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The effect of dietary supplementation of corn oil and vitamin E on the percentage and diameters of muscle fibers were determined for 24 crossbreed fatteners. The results of these investigations may suggest that the addition of vitamin E can influence the decrease in the percentage of white muscle fibers and increase the diameter of red and intermediate fibers. These changes can have some influence on meat consumption quality – especially meat colour.

INTRODUCTION

The use of plant oil in feed for fatteners can be very beneficial for consumers because of the improvement in the dietetic value of pig meat through the increase of unsaturated fatty acid levels. However, excessive essential fatty acid (EFA) levels in the fat of animals can have a negative effect on the sensory traits of meat and storage time. Vitamin E (tocopherol) belongs to the group of vitamins which are lipid-soluble and appear in 8 variants (α, β, γ, δ, ε, ζ, η, θ) with similar oxidative characteristics. The most common and effective is α-tocopherol, which is mainly present in plant oils, wheat and soy sprouts, and also in eggs, liver, milk and green vegetables. It can be also obtained though synthetic methods. Vitamin E protects the structure of cells against the destructive influence of free radicals and active lipids peroxidation. Meat with a bright red colour due to the presence of oxyMb is assumed to be fresh by the consumers, contrary to meat in which brown metMb predominates [Phillips *et al.*, 2001]. There are many reports on studies done on beef and pigs concerning the benefit of vitamin E added to feed for improvement of colour stability and diminished lipid peroxidation of meat products [Phillips *et al.*, 2001; Gatellier *et al.*, 2001; Houben & van Dijk, 2001]. Histochemical studies carried out on horses and pigs showed that lipids are stored between fasciculi, but also intracellularly, mainly in fibers I and IIA, which have higher oxidative capacity and less in fiber IIB [Essen-Gussavsson *et al.*, 1994]. There are well-known correlations between the percentage of fiber type and the consumption quality of meat and the influence of intramuscular fat on meat tenderness and palatability [Henckel *et al.*, 1997; Cameron *et al.*, 1998; Oksbjerg *et al.*, 2000]. There are few studies concerning the influence of vitamin E on histochemical reactions in muscle, which can have some effect on meat quality and consumption quality (colour, tenderness and juiciness). Therefore, the objective of this study was to investigate the influence of the addition of α-tocopherol in feed on the histochemical profile of *m. longissimus lumborum* of fatteners.

MATERIAL AND METHODS

The study was carried out on 24 crossbreed fatteners [(Polish Large White × Polish Landrace) × Pietrain] slaughtered at 105 kg. The pigs were divided into 2 feeding groups (n=12). Fatteners from both groups (control and experimental) were feed *ad libitum* with the same complete feed oil with the addition of 3% corn oil from 50 kg of body weight to 105 kg (slaughter weight). All feed used for both groups contained 20 mg of vitamin E/kg and for the experimental group an addition of 200 mg of vitamin E/kg was used. All pigs were kept separately with free access to water (nipple drinkers). Muscle samples (3 from each animal) for histochemical analysis were taken from the *m. longissimus lumborum* on the right side of the carcass immediately after slaughter (within 20 min) on the level of the last lumbar vertebrae and deep within the muscle. The muscle samples (about 15 g) were frozen in liquid nitrogen and stored at -80°C until histochemical analyses were performed. Transverse sections (10 μm thick) were cut at -20°C in a cryostat (Slee MEV, Germany). The activity of dehydrogenase NADH (diaphorase) was detected using specific histochemical tests [Dubovitz *et al.*, 1973] for distinguishing muscle fiber kinds: I – red fibers of very high activity, IIA – intermediate of medium activity, and IIB – white fiber of low activity. The incubation medium contained nicotinamide adenine dinucleotide ($NADH_2$) and nitro blue tetrazolium (NBT). To compensate for non-specific reactivity,

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a control test was performed, using the medium without the substrate. Stained sections, totaling 300 fibers, were examined by a computerized image analysis system (Multi Scan Base98) and the percentage distribution of fiber types and the fiber diameters was calculated according to Brook and Kaiser [1970]. The data was analyzed by analysis of variance. When significant ($p \leq 0.05$) effects were found, Student's *t*-test was used to compare means. The data was presented as means ± SE.

RESULTS AND DISCUSSION

A histochemical study of *m. longissimus lumborum* from both groups showed 3 types of muscle fibers (Figures 1 and 2). The percentage and diameter results of fiber types are presented in Table 1. The histochemical study showed that feed supplementation of vitamin E decreased the percentage of white fibers and increased the size of red and intermediate fibers. Several studies reported that fiber type, percentage and cross-area can have an influence on meat and consumption quality [Karlsson *et al.*, 1993; Larzul *et al.*, 1997; Maltin *et al.*, 1997; Cameron *et al.*, 1999; Fiedler *et al.*, 1999]. Cameron *et al.* [1998] suggested that the percentage of white fibers is negatively correlated with meat tenderness. Therefore, a statistically-significant decrease in white fiber percentage can probably predict better tenderness of meat from the experimental group. Variations in the composition of the muscle fiber is, on the one hand, affected by breed [Kłosowska *et al.*, 1994; Larzul *et al.*, 1997; Ruusunen & Puolanne, 1997] and age, and on the other hand, by feeding and method of animal keeping [Kiessling *et al.*, 1982] and intensive selection [Brocks *et al.*, 1998].

Fiber diameters can be influenced by feeding and changes in diameter size can influence meat quality. As shown by Migdał *et al.* [2002], for cross breed pigs [(Polish Large White × Polish Landrace) × Pietrain], in a histochemical study of *m. semimembranosus*, statistically significantly increased diameters of white and intermediate fibers were observed in pigs fed with CLA feed supplementation. Cameron *et al.* [1998] suggested that an increase in the fiber diameters of red fibers was negatively correlated with tenderness and positively with juiciness. On the other hand, an increase in the diameter of intermediate fibers can be connected with daily gain.

Meat colour is a major factor limiting the quality and acceptability of meat and meat products. The right colour of meat can be conditioned by the presence of ferrous oxymoglobin (oxyMb) [Philips *et al.*, 2001] which is directly connected with the percentage and diameter of the muscle fiber types [Warriss *et al.*, 1990].

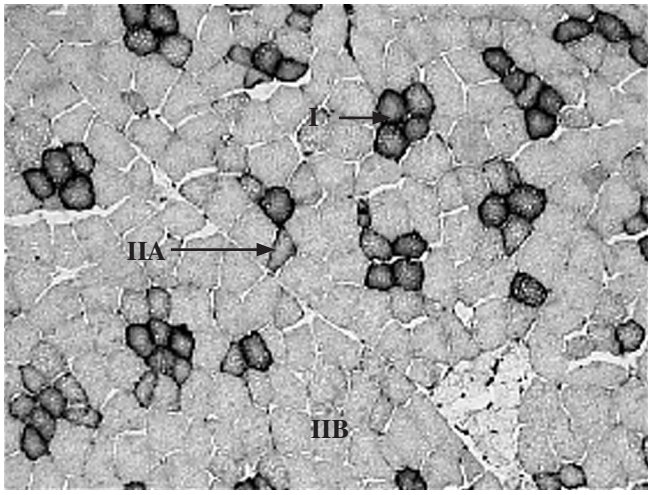

FIGURE 1. Cross section of *m. longissimus lumborum* in control group in pigs. Diaphorase activity reaction: I – red fibres, IIA – intermediate fibres, IIB- white fibres.

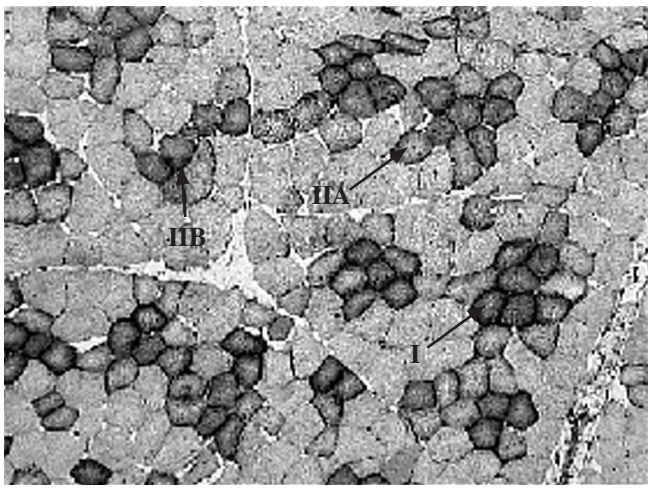

FIGURE 2. Cross section of *m. longissimus lumborum* in experimental group in pigs. Diaphorase activity reaction: I – red fibres, IIA – intermediate fibres, IIB – white fibres.

CONCLUSIONS

Therefore, one may conclude that the changes in size and number of muscle fiber types observed in this study, due to corn oil and vitamin E feed supplementation, could have had some influence on meat colour and consumption quality.

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TABLE 1. Percentage and diameters of muscle fibres in *m. longissimus lumborum* ($\bar{x} \pm SE$).

Traits	Percentage of fibres $\bar{x} \pm SE$		Diameters of fibres $\bar{x} \pm SE$	
	Control group n = 12	Experimental group n = 12	Control group n = 12	Experimental group n = 12
White fibres	74.18 ± 1.32^{x}	70.26 ± 1.1^{y}	76.10 ± 2.51^{x}	79.3 ± 2.88^{x}
Intermediate fibres	8.57 ± 1.02^{x}	10.28 ± 0.76^{x}	45.94 ± 5.4^{x}	69.4 ± 2.18^{y}
Red fibres	17.32 ± 0.86^{x}	19.40 ± 0.88^{x}	46.04 ± 4.25^{x}	62.38 ± 1.94^{y}

x, y – means with different letters (in rows) differ at $p \leq 0.05$

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WPŁYW OLEJU KUKURYDZIANEGO I OCTANU α–TOKOFEROLU NA PROFIL HISTOCHEMICZNY *M. LONGISSIMUS LUMBORUM* TUCZNIKÓW

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Na 24 tucznikach mieszańcach [(wbp × pbz) × pietrain] przeprowadzono badania histochemiczne dotyczące wpływu dodatku oleju kukurydzianego i witaminy E na zawartość procentową i średnicę włókien mięśniowych białych, czerwonych oraz pośrednich. Badania wykazały że, dodatek witaminy E może wpływać na spadek zawartości włókien mięśniowych białych oraz na wzrost średnicy czerwonych i pośrednich, co pośrednio może oddziaływać na jakość mięsa (barwa) (tab. 1, rys. 1, 2).