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MEAT COLOUR AND MUSCLE PIGMENT IN DANISH LANDRACE ANNO 1976 AND ANNO 1995

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Abstract

Recent studies suggest that selection for improved performance may cause deterioration in some meat quality traits of pigs through correlated responses. The present study was conducted with the purpose to compare meat colour and muscle pigment concentration in Danish Landrace pigs Anno 1976 and Anno 1995. Two groups representing the two types of pigs were performance tested from 40-95 kg live weight simultaneously. At slaughter, muscle samples were taken from *M. longissimus dorsi* (LD), *M. biceps femoris* (BF) and *M. vastus intermedius* (VI) and analyzed for pigment. Furthermore, haematin was determined in LD. Meat colour of bloomed (1 ha at 2°C) pork chops was measured by a Minolta Chroma Meter CR-300, with a D_{65} light source against white tile. Landrace pigs Anno 1995 grew 47% faster and consumed 29% less food per kg gain (Petersen et al., 1996). Furthermore, the pork chop colour of Landrace Anno 1995 was 9% lighter and 12% less red than 1976 pork chops. Accordingly, in 1995 pigs the pigment concentration was reduced by 20, 21 and 13% in LD, BF and VI, respectively. Heamatin of LD was reduced by 24%. These results suggest that along with increased performance, pork chops contain less pigment and appears to have lighter and less red meat. Whether this is due to correlated responses and/or different dietary level of iron per kg gain is not completely understood.

Introduction

Studies have indicated that along with improved performance the pigment (myoglobin) concentration in muscles of Danish purebred pigs declines over the years (Barton-Gade, pers. commun.). Because myoglobin is the major determinant of meat colour such a decline will probably cause lighter and less red meat. The present experiment was therefore initiated to further study meat

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colour and myoglobin concentration in meat of two groups of purebred Danish Landrace pigs representing performance characteristics of 1976 and 1995, respectively.

Materials and Methods

Two groups of purebred Landrace pigs were performance tested under similar conditions. One group of pigs (n=40) originated from a breeding test station, where the pigs were maintained since year 1976 without being selected for any traits. The other group of pigs (n=37) originated from Danish Landrace breeders and represented performance characteristics of year 1995. All pigs were fed the same diet from 40 kg live weight to 95 kg live weight. The experimental procedure has been described in more detailles elsewhere (Petersen et al., 1977). All pigs were stunned in CO_2 and bled. Within 45 minutes following slaughter, muscle samples were taken from *M. longissimus dorsi* (LD) at the level of the last rib curvature, *M. biceps femoris* (BF) and *M. vastus intermedius* (VI) for analysis of myoglobin. 24 hours post ortem meat colour of bloomed (1 ha at 2°C) pork chops was measured by a Minolta Chroma Meter CR-300, with a D_{65} light source against white tile. The tristimulus parameters L* a* and b*, representing lightness, redness and yellowness, respectively, were measured on four fixed sites of each chop surface.

Muscle samples were analysed for pigment (myoglobin) using a method modified after Trout (1991). 100 mg frozen muscle tissue is weighed and homogenized in 0.5 ML sodiumphosphate buffer (0.4 M, pH=6.5). After addition of further 0.5 ML sodiumphosphate buffer the homogenate is centrifuged at high speed for 5 minutes. To 700 µL of the supernatant, 200 µL of a 10% Triton X-1000 solution and 20 µL of 0.065 M sodiumnitrite are added. Followign 1 hour of incubation, this solution is centrifuged at high speed for another 5 minutes. 200 µL is then transferred to microtiterplates in triplicates and the absorbance is measered on an ELISA-reader at 405 mm (oxidized heme has max absorbance from 400 to 420 nm) and 750 to correct for turbidity. To calculate the heme content in the samples, the molar absorbance coefficient of 56,960 x 1 x mol^{-1} x 0.609 cm^{-1} (lenght of light path through wells) was determined using horse skeletal muscle myoglobin (Sigma M-0630, lot 55H7015). The myoglobin concentration in the samples was calculated in form the following equation:

Myoglobin, mg/g = $(\Delta A(1+W)x1.34 \times 17,800)/(Wx56960)$

where $\Delta A=A_{405} - 2.68 \times A_{750}$, W=weight of sample, and 17,800 is the molar weight of myoglobin.

Samples of LD was further analysed for pigment by a method modified after Hornsey (1956).

At exsanguation blood samples were collected for determination of hematocrit and hemoglobin content using Drabkin's Reagent.

Results

Landrace pigs anno 1995 grew 47% faster and consumed 29% less feed per kg gain compared to pigs anno 1976 (see also Petersen et al., 1997).

The colour of pork chops also differed between the groups. Thus pork chops of pigs anno 1995 was 9% lighter and 14% less red than pork chops from pigs anno 1976. Accordingly, the myoglobin concentration in muscle samples from pigs anno 1995 waas 20%, 21% and 13% lower in LD, BF and VI, respectivily, than in muscle samples obtained from pigs anno 1976. A similar difference between groups in myoglobin content of LD was found using the Hornsey-method.

Table 1 - MEAT COLOUR AND MUSCLE PIGMENT IN DANISH LANDRACE ANNO 1976 AND ANNO 1995

	Anno 1976	Anno 1995	RootMSE	P	% change
Meat colour of chops					
L*	49.8	54.3	2.09	***	10
a*	9.1	8.1	1.10	***	12
b*	7.2	7.5	0.92	ns	4
Myoglobin, mg/g^{-1}					
LD.	1.020	0.848	0.183	***	20
BF.	2.148	1.775	0.483	***	21
VI.	6.011	5.365	0.633	***	13
Hematin, ppm^{2}	29.1	22.4	3.80	***	29
Vascular traits,					
Blood, kg	3.57	3.97	0.30	***	11
Heart, g	304	341	30	***	12
Hematrocrit	47.0	45.8	2.89	ns	2.6
Hemoglobin, mmol	9.09	8.78	0.52	*	3.6

[1] Myoglobin measured accordance with the method modified after Trout (1991)

[2] hematin of LD meased in accordance with the Hornsey method

Simple correlations coefficients among colour traits and myoglobin content was estimated separately for the two groups of pigs (Table 2).

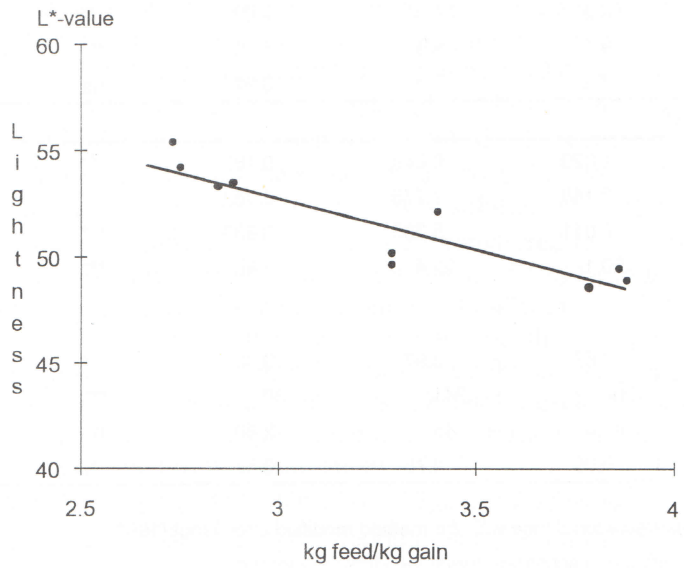
Table 2 - SIMPLE CORRELATION COEFFICIENTS BETWEEN COLOUR (L*, A* AND B*) AND MYOGLOBIN IN PIGS ANNO 1976 (ABOVE DIAGONAL) AND PIGS ANNO 1995 (BELOW DIAGONAL)

	L*	a*	b*	MyoLD	MyoBF	MyoVI	Hematin
L*		20	73***	2	26	27	-34*
a*	-37*		79***	35*	19	-1	67***
b*	36*	68***		26	24	-15	23
MyoLD[1]	-38*	55***	25		2	4	32*
MyoBF[1]	-41*	48***	22	62***		-26	3
MyoVI[1]	-19	24	1	42*	21		5
Hematin[2]	-57***	70***	22	61***	51**	34*	

[1] MyoLD, MyoBF and MyoVI are myoglobin concentration in LD, BF, and VI measured by a method modified after Trout (1991).

[2] Haematin is measured in LD after the Hornesey-method.

Fig. 1 - RELATIONSHIP BETWEEN KG FEED: KG GAIN AND LIGHTNESS (L*) OF PORK CHOPS. EACH POINT IS AN AVERAGE OF 6 OR 7 PIGS/PEN.



In pigs anno 1976, L* only correlated with the myoglobin concentration analysed by the Hornsey method (r=0.34*). The readness (a*) correlated significantly with the myoglobin concentration in LD analysed after the Hornsey method (r=0.67**) and after the modified Trout method (r=0.35*). The myoglobin concentration analysed by the two methods was positively correlated (r=0.32**). The myoglobin concentration was unrelated among muscles.

In pigs anno 1995, both L* and a* correlated with the myoglobin concentration analysed after the Hornsey method (r=-0.57** and r=0.70**) and after the Torut method (r=-0.38* and r=0.55***). The myoglobin concentration in LD analysed after the two methods was positively correlated (r=0.61). Positive correlation coefficients were found among muscles with respect to the myoglobin concentration. The hemoglobin content was negatively related with L* (r=-0.54).

An inverse relationship between kg feed: kg gain was found an illustrated in Fig. 1.

Discussion

The present study showed that pigs anno 1995 produced significant lighter and less red pork chops than pigs anno 1976. Because myoglobin is a major determinant of a* (Table 2), the observed change in a* is probably related to the lower concentration of myoglobin. Thus, it was found that the myoglobin concentration in LD and BF was reduced by 20% and by 13% in VI in pigs anno 1995 compared to pigs anno 1975. These results suggest that along with increased performance charecteristics of pigs due to selection, lighter and less red meat may result. The reason for this is unknown. However, for both pig types, the amount of feed consumed per kg gain was found to be negatively correlated with the L* value. The myoglobin concentration increases with increasing age (weight) and the ratio of the rates of increase in myoglobin to overall muscle growth may have decreased. Alternatively, the difference may be related to different intake of dietary iron. Thus, because the pigs were fed the same diet, the pigs anno 1976 consume 29% more iron per kg gain than anno 1995 pigs.

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BOJA MESA I PIGMENT MIŠIĆA U DANSKOG LANDRASA GODINE 1976. I GODINE 1995.

Sažetak

Prema novijim istraživanjima selekcija na bolju performancu može prouzročiti pogoršanje (gubitak vrijednosti nekih osobina kakvoće svinjskog mesa zbog korelativnih reakcija. Ovo je istraživanje provedeno radi usporedbe boje mesa i koncentracije pigmenta mišića u svinja danskog landrasa godine 1976. i 1996. Dvije su skupine, što su predstavljale dva tipa svinja, istodobno testirane na performancu od 40 do 95 kg žive vage. Kod klanja uzeti su uzorci mišića M. longissimus dorsi (LD), M. biceps femori (BF) i M. vastus intermedisu (VI), te analizirani za pigment. Osim toga, određen je hematin u LD. Za mjerenje boje mesa svježih (1h na 2°C) svinjskih kotleta upotrijebljen je Minolta Chroma Meter CR-300 s izvorom svjetla D_6 prema bijeloj pločici. Svinje Landras 1995. godine rasle su 47% brže i trošile 29% manje hrane na kg prirasta (Petersen et al., 1996.). Nadalje, boja svinjskih kotleta Landrasa godine 1995. bila je 9% svjetlija i 12% manje crvena nego boja svinjskih kotleta 1976. Prema tome, u svinja 1995. godine koncentracija pigmenta bila je smanjena za 20, 21 i 13% u Ld, BF odnosno VI. Hematin u Ld-u bio je smanjen za 24%. Ti rezultati navode na zaključak da uz povećanu performancu svinjski kotleti sadržavaju manje pigmenta, a meso izgleda svjetlije i manje crveno. Je li to zbog korelativne reakcije i/ili različite količine željeza u hrani na kg prirasta nije potpuno jasno.

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