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PROTEIN BOUND IODINE AND MUSCLE PIGMENTS IN PIGS.

by
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It has often been observed that along with a general progress in the pig production /better feed conversion, increased leanness of carcass etc./ the quality of the produced meat is declining. The assumption is that a defective function of the endocrine, particularly the thyroid system, is the cause of these qualitative changes, which bring about a condition known as "muscular degeneration"/MD/ as described by Ludvigsen /1954/.

The main symptoms of MD are alterations in the muscles, manifesting themselves most conspicuously by a discoloration of the meat, which assumes a characteristically pale colour. In extreme cases the meat thus affected shows a greyish-white shade resembling that of chicken or fish meat. It is also supposed that the various transitional forms of discoloration are associated with a predisposition of the animals to MD /Ludvigsen, 1957/

In this connection the question arises whether in general the colour of meat is in any way affected by the function of the thyroid gland. Such conjecture might find its corroboration in the fact that there exists a correlation between the content of myoglobin and the activity of the respiratory enzymes in the muscles /Lawrie, 1952/ as well as in the lately found association of the colour of pig meat with feed efficiency /Osinska and Kielanowski 1960/.

It was thus the purpose of the present work to establish the relationship between the level of protein bound iodine /PBI/ in the blood serum and the content of muscle pigments which are mainly responsible for the meat colour /Janicki and Kolaczyk, 1960/

Materials and methods.

The investigations have been carried on during the months of March, April and May on 32 healthy, normal bacon pigs of Large White breed, 16 gilts and 16 barrows. The animals were taken from a Progeny Testing Station where they were fed uniformly and slaughtered under standard conditions at 96 kg. l.w./Kielanowski et al. 1957/ The average daily gain during the 40-90 kg. l.w. period amounted to 634,5 g, the feed efficiency to 3,98 scandinavian fed units per 1 kg. live weight gain.

Three days before slaughter, in the morning, blood was taken from the ear vein of each animal. In the centrifuged blood serum the protein was precipitated with $Zn\,SO_4$ and the PBI determined by the method of alcaline incineration/Barker et al. 1951/. Time of reaction was 30 minutes at 20°C measurements of transmission were taken at 420mu

After 48 hours' refrigeration of wholesale cuts, the loins were carved out and the visible aggregates of connective tissues and fat carefully trimmed off. The segments of longiss. dorsi muscles situated against the last six thoracic vertebrae were quickly cut up and minced twice in a meat grinder, then mixed thoroughly. The total amount of pigment has been determined according to the method of Wierbicki et al./1953/ but with an overnight extraction. The content of myoglobin has been determined according to Ginger et al./1954/

Statistical analyses have been made by the methods given by Snedecor /1956/.

Results:

Data showing the mean values of the characteristics investigated including their variations are presented in Table 1. Simple correlation coefficients obtained between PBI level and the total content of pigment and myoglobin are given in Table 2 showing also the degree

of the statistical significance of the correlations computed.

Table 1.

Mean values /$\bar{x}$/ their standard deviations /s/ and coefficients of variation /C/ of the characteristics investigated.

Characteristics investigated		$\bar{x}$	s	C
PBI level	ug%	6.8	1.05	15.5
Total pigment	mg%	86.5	15.22	17.6
Myoglobin	mg%	66.5	11.59	17.4

Table 2.

Simple correlation coefficients/r/ between PBI level and pigment content in muscles.

PBI	r
Total pigment	0.4116 x
Myoglobin	0.4911 xx

x significant at P 0.05

xx " at P 0.01

Discussion.

The PBI level in the blood serum is now more and more believed to be an adequate of thyroid activity /Rapport and Curtis 1950/.There are indications that the PBI level may be used as a partial index of the growth potentialities and the potential efficiency of feed utilisation /Kunkel and al.1953

Gawienowski et al.1955; Sørensen and Moustgaard,1957/. No data are available so far with regard to the influence that PBI might have on the quality of meat.

Though several factors are responsible for the colour of raw pig meat,the variability of colour is caused primarily by the content of pigments /Janicki and Kołaczyk, 1960/.These are myoglobin,hemoglobin and cytochromes.Hemoglobin amounts to about 10 per cent of the total amount of pigments /Shenk et al.1934/ and has consequently but a slight influence on the colour of meat under conditions of normal bleeding.The quantities of cytochromes are also too small to be of any practical importance/Hamm,1954/. It is,therefore,the content of myoglobin that is mainly responsible for the colour of normal meat.

The experiment was carried out under standard conditions of feeding,management and slaughter of animals. The averages and varaiances of the characteristics investigated did not differ essentially from the data given by other authors with the exception of the average level of PBI in the blood serum of the examined pigs which was relatively high /Table 1./The respective values,found by other authors were on the whole lower and amounted in Denmark to 2,7 ug% for Landrace and 4,4 ug% for Large White /Sørensen and Moustgaard,1957/,in USA to 3.08 ug% for Hampshire /Gawienowski et al.1955/.

There many possible explanations for the high PBI values in the blood sera of the pigs in this experiment. It is known that PBI level differs among breeds /Long et al.1952/; Reece and Man,1952/ and is influenced by the environment in which the animals live/Ewy and Bobek 1959/.The high levels of protein bound iodine may also find their explanation in the fact that PBI is correlated with feed efficiency /Kunkel and al.1953/ which was relaitively low in our experiment.Moreover it has been

pointed out that PBI level in the blood may be even twice as high in spring as in summer /Branton et al.1955/

The main physiological function of myoglobin consists in securing a constant supply of oxygen to the muscle respiratory system and maintaining an optimal oxygen gradien ent between the cell membrane and the mitochondria/Voughan and Pace,1956/,Lawrie/1952/,pointed out that the difference in the content of myoglobin are in general associated with the activity of the muscle cytochrome system. This is in accordance with the simultaneously discovered fact that the porphyrins are produced in the organism in connection with the cycle of the tri-carboxylic acids / Shemin and Kumin,1952/. It means that both processes i.e. the production of heme pigments and the respiration are, at certain stages,coupled with each other.Consequently the influence of the thyroid activity on tissue oxidations being well known /Brody,1945/,it might be expected that there exists a correlation between PBI level and myoglobin content in muscles.

The computation og the data obtained in our experiment /Table 2/ has proved,that the myoglobin content in meat is

meat is positively correlated / at P 0.01/ with PBI level in the blood serum.The correlation coefficient of total pigments with PBI was significant at P 0.05 only. The difference in the level of significance between two coefficients may be caused by the fact,that the hemoglobin content in meat,which depends on the degree of bleeding of animals,is rather highly variable and makes the correlation found between PBI level and myoglobin content seem less obvious.

It follows from the above,that,in normal pigs,an increased concentration of PBI in blood is associated with an increase of the content of myoglobin in the meat. This means in the practice,that the meat of pigs with

a higher thyroid activity is darker while a reduced function of the thyroid gland, even in the range of normal variability, results in a lightening of the colour of the meat.

Thus, the transitional form of meat paleness, observed in pigs having a predisposition to MD /Ludvigsen, 1957/ might simply be considered as the result of a further decrease of the thyroid activity. This conclusion fits into the general picture of MD, as proposed by Ludvigsen/1954/

The correlation found between PBI level and myoglobin is in accordance with the recent findings of Osinska and Kielanowski /1960/, concerning the correlation of the colour of pig meat with feed efficiency. Though this association has been demonstarted for the summer season only, there seems to be no doubt that it is based on the correlation between PBI level and the feed efficiency /Kunkel et al. 1953/.

The relationship between PBI and myoglobin in pigs may be of some practical value. Colour has so great an importance for a further utilisation of meat, that it cannot be overlooked in the selection of animals. In Danish Progeny Testing Stations the assessment of the meat colour has therefore been introduced as a routine procedure already in 1954 /Clausen and Thomsen, 1960/. In our opinion such routine evaluation of meat colour should be introduced in all progeny testing stations. It would not only satisfy the consumer of meat but may also be considered, in the light of our results, as an indirect practical measure of the basal metabolic rate, the importance of which is more and more being stressed in the modern literature on the selection of animals /e.g. Kielanowski, 1957/.

Summary.

Protein bound iodine in the blood serum together with total pigment and myoglobin in the meat, were determined in 32 healthy normal pigs. Significant correlation was found between PBI and total pigment $r=0.412^{x}$ as well as between PBI and myoglobin $r=0.491^{xx}$

Physiological and practical aspects of the correlations were discussed.

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Poziom jodu związanego z białkiem a barwniki mięśniowe u świń.

Streszczenie.

U 32 zdrowych normalnych świń typu bekonowego oznaczono PBI w surowicy krwi oraz barwniki całkowite i mioglobinę w mięsie. Znaleziono statystycznie istotną korelację między PBI a barwnikami całkowitymi $r=0.412^{x}$ i między PBI a mioglobiną $r=0.491^{xx}$

Omówiono fizjologicznie i praktycznie aspekty znalezionej zależności.

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