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EFFECT OF MYOGLOBIN IRON CONTENT OF MUSCULAR TISSUE ON THE CONCENTRATION OF NITROSOMYOGLOBIN ON THE PROCESS OF TISSUE CURING

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A.K. Iskandaryan

S U M M A R Y

Studies were carried out concerning the effect of myoglobin iron content of muscular tissue on the formation of nitrosomyoglobin in the process of curing beef and pork. Pieces of beef and pork loin (longissimus dorsi) were taken as samples for curing and determination of myoglobin iron content.

It was found that there is a direct dependence between the concentration of nitrosomyoglobin in cured meat and the content of myoglobin iron in muscular tissue. When curing beef and pork under the same conditions, the concentration of nitrosomyoglobin in cured beef is twice as large as that of cured pork.

This paper may serve as a substantiation of dependence between intensity of muscular tissue colour and content of irony compounds in feeds which are fed to animals of certain age and finish.

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BEEINFLUSSUNG DER NITROSOMYOGLOBINSKONZENTRATION DURCH DEN EISENMYOGLOBINGEHALT DES MUSKELGEWEBES WÄHREND DESSEN PÖKELUNG

A.K. Iskandarian

Z U S A M M E N F A S S U N G

Der Einfluss des Eisenmyoglobingehaltes des Muskelgewebes auf die Konzentration des Nitrosomyoglobins während der Pökelung des Rind- und Schweinefleisches wurde untersucht. Zur Untersuchung wurden Filetstücke des Rind- und Schweinefleisches genommen.

Es wurde festgestellt, dass die Konzentration des Nitrosomyoglobins des gepökelten Fleisches zu dem Gehalt an Eisenmyoglobin im Muskelgewebe in einer direkten Abhängigkeit steht. Bei der Pökelung des Rind- und Schweinefleisches unter gleichen Verhältnissen war die Konzentration des Nitrosomyoglobins des gepökelten Rindfleisches etwa doppelt so hoch wie die des gepökelten Schweinfleisches.

Die angeführten Angaben können zur Bestimmung der von dem Gehalt an den Eisenverbindungen abhängigen Färbung des Futters benutzt werden.

INSTITUT DE RECHERCHES SCIENTIFIQUES DE L'INDUSTRIE DE VIANDE

DE L'URSS.

L'INFLUENCE DE LA TENEUR EN FER DE MYOGLOBINE DU TISSU MUSCULAIRE SUR LA CONCENTRATION DE LA NITROSOMYOGLOBINE AU COURS DE LA SALAISON

A.K. Iskandariane

S O M M A I R E

L'influence de la teneur en fer de myoglobine du tissu musculaire a été investiguée au cours de la salaison de viande de boeuf et de porc. Pour les tests on a pris des morceaux de filet de boeuf et de porc (longissimus dorsi).

Il a été mis en évidence que la concentration de la nitrosomyoglobine de la viande salée est la fonction directe de la teneur en fer de myoglobine du tissu musculaire.

Les mêmes conditions de salaison de la viande de boeuf et de celle de porc engendraient des concentrations différentes; la concentration en nitrosomyoglobine de la viande de boeuf étant deux fois plus élevée que celle de la viande de porc.

Les données du rapport peuvent servir de base pour établir la coloration du tissu musculaire en fonction de la présence des composés de fer dans les aliments des animaux d'un âge et d'un engraissement donnée.

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Iskandaryan A.K.

In earlier works (I,2,3,4,5) on studying ways of pork curing intensification and improvement of cured pork quality we showed that a possibility exists to hasten the process of curing and to obtain a cured product with ham properties provided the meat is subjected to autolysis beforehand and the curing is carried out under conditions favourable for the development and preservation of suitable microflora in the brine. These studies as well as the studies of other authors on adding into brines phosphates (7,8,9,I0), ascorbic acid and its derivates (II,I2,I3,I4,I5,I6,I7,I8,I9,20) reflect the influence of external factors on the process of meat curing. But studies on the meat quality as affected by intravital changes of chemical and biochemical composition of animal muscular tissue began comparatively recently. For example, Wismer-Pedersen (2I,22,23) showed in his paper that the quality of bacon can be improved by adding sugar to pig rations. According to other authors (24) the colour of muscular tissue is more intense when pigs received maize and barley in the ration.

The colour (pigmentation) of raw muscular tissue is of extemely great importance for producing cured meat with a stable rose-red colour. The intensity of pork muscular tissue colour depends principally on their content of myoglobin. The higher the myoglobin content of muscles, the brighter their colour, and vice versa, the less myoglobin, the paler muscles (25). The myoglobin content of muscular tissue per gram of raw meat is: of a calf - I-3 mg, of an ox - 4-I0 mg, of a pig - I-3 mg (26).

The myoglobin content of muscular tissue can be changed artificially. It is know that the physical training of muscles results in the accumulation of myoglobin in them (25). The increase of the myoglobin content of muscles is also affected by iron ions in grain and other feeds. Therefore, methods of feeding suckers with iron citrate (27) and calves with iron sulphate (28) were described. According to these data the addition of iron ions to animal feed increases the intensity of muscle colour. Jacobson and Fenton (28) asserted that the increase of the intensity of muscle tissue colour depends on the insrease of total iron content of this tissue.

We found that there are no data in the literature concerning the influence of irony compounds on the pork colour after curing.

To affect the change of the intensity of meat colour in the cure it is important to determine the content of iron ions of myoglobin molecules rather than total content of iron ions in muscular tissues, since the pigment nitrosomyoglobin, which is produced in the curing, is the product of the reaction of myoglobin molecules iron ions with nitric oxide (26). Therefore, before solving the problem of the influence of irony compounds on the colour of cured pork it is necessary to find out how the myoglobin iron content of muscular tissue affects the nitrosomyoglobin concentration in the process of curing.

When solving this problem we prepared myoglobin solution by the method of W.Bowen (29). The advantage of this method over the well-known method of Theerell (30) is its simplicity and a good yield of myoglobin solution. The determination of the iron content in the myoglobin solution produced was made by the same α - dipyridyl method of Delory (31), used by Bowen (29).

To produce myoglobin solution by the Bowen's

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method (29) we cut meat samples (without fasciae and fat) of 500-600 g of weight from loins (longissimus dorsi) of three recently slaughtered pigs and three beef carcasses. Then the samples were immediatelly dipped into 0,85% sodium chloride solution chilled to 2°C. It was done for removing remaining blood from tissues and preventing myoglobin from oxidizing into metmyoglobin by the air oxigen. Then I00-I50 g pieces of meat were cut from every sample for posterior curing, and the remaining big pieces of meat were used for preparing myoglobin solution according to the Bowen's method (29).

To determine iron in pork we took I ml of the prepared myoglobin solution, and in the case of beef - 0,5 ml. The content of iron was calculated by the dry weight of myoglobin, obtained by reducing to the constant weight under vacuum in an exsiccator containing phosphorous pentoxide.

The results of the determination of iron in pork and beef myoglobin are shown in Table I.

Table I

Quantity of iron in myoglobin of loins of beef and pork carcasses*

Number of parallel experiments	Beef loin		Pork loin
	Quantity of myoglobin iron (%)		
I	0,3I8	636	0,3I7
2	0,33I	662	0,325
3	0,344	688	0,345

* The quantity of iron in hemoglobin is not taken into account since in a bloodless muscle more than 95% of the total iron is in myoglobin (26).

As it is shown in Table I the content of myoglobin iron in beef loin is approximately twice as large as that of pork loin (the analysis ratio of the beef myoglobin solution to the pork myoglobin solution was 2:I), i.e. the quantity of myoglobin in the beef samples was almost twice as large as that of the pork samples.

The data shown in Fable I confirm the well-known fact that the content of iron in myoglobin of different animals has the same value (23).

Later experiments on meat curing were carried out in which the quantity content of myoglobin iron was determined by the above described method. The aim of these experiments was to find out how the content of myoglobin iron in the tissue to be cured affects the concentration of the nitrosomyoglobin appearing in curing.

For this aim pieces of loin (from the samples in which the content of myoglobin iron was determined) were subjected to a 24 hours autolysis. Then they were dipped into the brine containing 20% of sodium chloride and 0,05% of sodium nitrite to the weight of the brine. The ratio of the weight of the meat and the weight of the brine was 1:1. The curing lasted 5 days. The temperature of the brine was about 15°C. After curing the cured meat was kept for 1,5 hour in a refrigerator at about 2°C for draining. Then the cured meat was comminuted in an ice-cooled grinder. The comminuted meat was collected into chemical glasses which were also ice-cooled. The coolong was made to prevent myoglobin from being oxidized into metmyoglobin with air oxygen. Then, 5 g of minced meat were taken from each sample and placed into a dividing funnel with a capacity of 50 ml with a ground glass stopper. The extraction was made two times by adding into each funnel 25 ml of

ethyl alcohol cooled down to 4°C *. After an intense mixing for 5-6 minutes, the filtration of the alcohol extract was made in an ice-cooled funnel (32). The filtrate of nitrosomyoglobin was collected into an ice-cooled chemical glass.

The determination of the concentration of nitrosomyoglobin in cured beef and cured pork extracts was made by a colorimeter meth d by comparative estimation of the optical density of each alcohol extract. With this aim the electric photocolorimeter FEK-M was used. A green heliofilter was used. To determine the value of the optical density of the extracts and the zero point of the galvanometer the absolute ethyl alcohol was used.

The determination of the optical density of the beef nitrosomyoglobin extract was made diluting it twofold with the ethyl alcohol.

The results of the photocolometric analysis are shown in Table 2.

Table 2

Values of the optical density of alcohol extracts of cured beef and pork nitrosomyoglobin

Numbers of parallel samples	Beef		Pork
	Optical density		
1	2,0	4,0	1,7
2	2,3	4,6	2,0
3	2,8	5,6	3,0

Taken into account the fact that the extract of beef nitrosomyoglobin was diluted twofold prior to colorimetering, the concentration of cured beef

* The extraction of nitrosomyoglobin is made by the absolute ethyl alcohol with the ratio of the alcohol to minced meat 5:1 (32).

nitrosomyoglobin, as is shown in Table 2, is about twice as high as that of cured pork nitrosomyoglobin.

The compatison of the results shown in Tables 1 and 2 allows us to make the conclusion that the concentration of nitrosomyoglobin in beef cured under the same conditions depends on the content of myoglobin iron in muscular tissue. Thus, by changing the concentration of myoglobin iron in muscular tissue it is possible to obtain a cured product with the desirable colour. The higher myoglobin iron content in muscular tissue, the higher nitrosomyoglobin concentration, and vice versa, the lower myoglobin iron concentration, the lower nitrosomyoglobin concentration.

This paper may serve as a substantiation of dependence between intensity of muscular tissue colour and content of irony compounds in feeds which are fed to animals of certain age and finish.

Conclusions

1. There is a direct dependence between the concentration of nitrosomyoglobin in cured meat and the content of myoglobin iron in muscular tissue.

2. When curing beef and pork under the same conditions the concentration of cured beef nitrosomyoglobin is about twice as high as the concentration of cured pork nitrosomyoglobin.

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