COLOUR INDEX OF MEAT PRODUCTS

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The purpose of standarization is to obtain meat products of constant chemical composition and quality features. These ought to be acieved independently on natural variability as well as on that caused by use of meat exchangers.

One of the most important quality parameter of meat products is its colour. We found that the colour brightness might be calculated from the fat and meat pigments contents data. The most convenient equation describing that relation was:

$$\text{Brightness} = A \cdot T + \frac{B/100 - 1{,}11T/}{P} + C$$

where T = fat content /%/
P = meat pigments content /ppm/
A,B,C = empirical constants

In the case of cured meat products the parameters T and P determined also the hue.

The dependences among fat, protein and meat pigments contents in raw materials were calculated with defining the colour index. That made possible to programme the colour of meat product by selection the right proportion of ingredients.

Index de couleurs pour produits à base de viande

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La standarisation a comme but d'elaborer des produits d'une composition chimique constante, qui puissent garder les mêmes characteristiques de qualité independamment de la variete des matières premieres tant naturelles qu'additionnées de substitus.

L'une des characteristiques principalles c'est la couleur. On a admis que l'agent principal qui determine la brillance de la couleur des produits à base de viande c'est la quantite de graisse /clair/ par rapport aux autres composants /sombre/; l'agent qui determine la teinte de la couleur c'est la quantité des colorants. On a élaboré une formule pour calculler la brillance de la couleur avec la teneur en graisse et la quantité des colorants:

$$\text{Brillance} = A \cdot T + \frac{B/100 - 1{,}11 \cdot T/}{P} + C$$

ou T = teneur en graiss /%/
P = collorants /PPM/
A,B,C = valeurs constants

Dans le cas de produits à base de viande traités par saumurage, les parametres T et P determinnent aussi la teinte de la couleur.

On a fixé une relation entre la teneur en graisse, proteins et colorants, qui sert comme index de couleurs pour les matières premieres. Ainsi il est possible de programmé la couleur des produits par un choix exacte d'une proportion des composants.

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Indexe der Farbe der Fleischprodukte

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Die Standardisierung verfolgt die Erlangung der Fleischprodukte, die unabhängig von der natürlichen sowie auch von der von der Substitution verursachten Veränderlichkeit der Rohstoffe die ständige chemische Zusammensetzung und wiederholbare qualitativen Eigenschaften besitzen. Die Farbe ist eine der wichtigsten qualitativen Eigenschaften. Man hat vorausgesetzt, dass die Proportion des /weissen/ Fettes zu den übrigen /dunklen/ Bestandteilen der die Farbhelligkeit der Fleischprodukte determinierende Grundfaktor ist. Die Menge der Hämfarbstoffe ist der den Farbton determinierende Faktor. Man hat die die Farbhelligkeit mit dem Fett-und Farbstoffgehalt verbindende Formel festgestellt. Die beste Übereinstimmung hat man für die folgende Gleichung erzielt

$$\text{Helligkeit} = A\,T + \frac{B/100 - 1{,}11\,T/}{P} + C$$

Symbole:
T = Prozentgehalt des Fettes
P = Muskelfarbstoffe /PPM/
A,B,C = empirische Konstanten

Für die aus dem Pökelfleisch verarbeiteten Fleischprodukte die Parameter P und T determinieren auch den Farbton.

Es wurde die Abhängigkeit des Fett- und Eiweissgehaltes sowie auch der Menge der Farbstoffe festgestellt, wobei man den Index der Rohstoffarbe geschaffen hat. Es ermöglicht die Programmierung der Farbe der Produkte bei der Auswahl der entsprechenden Proportionen der Bestandteile.

Показатель окраски мясных продуктов

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Стантартизация идёт в направлении получения мясных продуктов с постоянным химическим составом и повторяемых качественных свойствах независимо от изменений сырья, так естественных как и с заменителями мяса /другими добавками/.

Одним из самых главных качественных показателей является окраска мяса. Принято, что основным фактором определяющим яркость окраски мясных продуктов является пропорция жира /белого/ к остальным составным частям /тёмным/, а фактором определяющим цветовой тон является количество гемовых пигментов. Разработано формулу связывающую зависимость яркости окраски с содержанием жира и пигментов.

Самую лучшую сходность получено для управления:

$$\text{Яркость} = A.T + \frac{B/100 - 1.11\,T/}{P} + C$$

где T - содержание жира, %
P - количество мышечных пигментов
A,B,C - эмпирическая константа

В случае продуктов из посоленного мяса параметры T и P определяют тоже цветовой тон. Определено зависимости между содержанием жира, содержанием белка и количеством пигментов сырья, которые образуют показатель окраски сырья. Эти зависимости позваляют программировать окраску продуктов подбором пропорции по отношении к основным компонентам.

COLOUR INDEX OF MEAT PRODUCTS

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The purpose of steering the quality of meat products is to obtain these products of standard quality. It means that they ought to have standard chemical composition, standard sensory features and colour. The last one is particularly difficult to standardize especially when meat exchangers /non-meat proteins/ are used. The difficulty of objective colour determination in connection with characteristics of raw materials gives an additional complication. Therefore the problem of developing a system of steering the colour in meat products is rather a complex task. This paper is an attempt to solve this problem.

The colour of meat as well as colour of any kind of chromatic body is determined univocally by three physical parameters: dominant wavelength, brightness and saturation, calculated for different normalized light sources. These parameters can be calculated from reflectance spectra of meat products using the CIE calculation system.

It is known from our previous papers that the colour of cured cooked meat products can be characterized by using a simplified procedure basing on measuring reflectances at two wavelengths: 540 and 640 nm only. The reflectance at 540 nm is the measure of sample brightness and the ratio of the reflectance at 640 to that at 540 nm is the measure of hue and saturation. The adventage of this system is its independence of light sources.

The above mentioned system was used in the experiments described in this paper.

The characteristic colour of cured meat is a result of the presence of mioglobin and some amounts of hemoglobin, mostly in a form of nitric-oxide pigments. There exists a relationship between the amount of meat pigments and the spectral characteristics of meat colour, however, for various reasons one-factor relations between them are not very significant. One of these reasons is the way colour is being determined. It is made by measuring reflectance spectra and therefore it depends on various sample properties such as transparency, smoothness, uniformity, shape etc. Beside this the variability of pigment contents in various muscles is rather small.

In contrary to this sausages contain fat in rather large and varying amounts. Fat makes the mixture brighter and dilutes the meat pigments what is followed by increase in variability of meat pigment contents. When meat exchangers are used, other substances not containing meat pigments are incorporated into the meat mix, although they are not completely achromatic. It must be said that the artificial coloured protein preparations are not taken into account in this paper.

In order to find the relationship between the contents of meat pigments in raw materials and the colour of products, the chemical composition and spectral characteristic of 36 samples in more than ten model sausages were analysed.

It was assumed that the percentage of reflectance for the sample was equal to the mean value obtained for the surface of fat tissue, having a constant specific reflectance coefficient, and the surface of protein solution having reflectance coefficient inversely proportional to its pigment concentration.

The relationship between colour brightness, fat contents and contents of meat pigments was calculated by means of regression analysis. This is described by the equation:

$$Y = 0,83T + \frac{37,34\ /100 - 1,11T/}{P} - 10,91 \qquad /1/$$

where Y = colour brightness / % of reflectance at wavelength 540 nm/
T = fat contents /%, w/w /
P = meat pigments contents /ppm/

The multiple correlation coefficient for this relation was 0.767. Its relative low value was due to low repeatability of brightness determination on various sausage surfaces while the chemical analyses were made in homogenous samples.

In the case of cured meat the variability of dominant wavelengths was negligible. Therefore it was possible to determine the relationship between the colour hue, fat and contents of meat pigments. The colour hue was characterized by the ratio of the percentage of reflectance at 640 nm to that at 540 nm. It was described by the following equation; where $\lambda_d = R_{640}/R_{540}$:

$$\lambda_d = 5,49 - /0,068T + 1,93\ \frac{100 - 1,11T}{P}/ \qquad /2/$$

The respective multiple correlation coefficient was 0.725.

For practical consideration it was then necessary to determine the colour index. From many experimental data which had been collected previously, the relationship between the amount of meat pigments, protein and fat contents in raw materials was determined. These data are presented in Table 1. The colour index is based on following empirically calculated relations:

$$\beta = \frac{P}{B} \qquad /3/$$

$$a = \frac{100 - T}{B} \qquad /4/$$

where P = contents of meat pigments /ppm/
B = protein contents /%/
T = fat contents /%, w/w /

Using the colour index and basing on sausage recipes the contents of meat pigments in different kinds of model sausages were calculated. The same was done for fat contents. The model sausages were produced in the processing hall of our Institute.

Generally, a good agreement between theoretically calculated and empirically determined values for fat contents and a little worse one for the contents of meat pigments were obtained. In the last case the empirically determined values of meat pigments contents were a little higher than the expected ones.

Next the validity of equation /1/ was tested on the same group of model sausages. On the base of colour index the expected colour brightness of the product was calculated. The results obtained can be seen in figure 1. It can be said that generally the results obtained in this way looked promising. Further experiments in this field are going on including use of achromatic meat exchangers.

Table 1 Colour index

Classes of raw materials	Fat contents, % /mean value/	β	a
lean pork trimmings I	7,1	7,4	5,16
fat pork trimmings I	12,5	7,4	5,16
very lean pork trimmings II	27,3	7,4	5,00
lean pork trimmings II	33,3	7,4	5,00
medium fat pork trimmings II	42,9	7,4	5,00
fat pork trimmings II	47,4	7,4	5,00
very fat trimmings II	51,1	7,4	5,00
lean pork trimmings III	19,2	7,4	4,85
fat pork trimmings III	29,1	7,4	4,85
lean beef I	3,0	11,4	4,62
lean beef I /high connective tissue contents/	7,0	11,4	4,62
beef II	7,0	11,4	4,89
beef III	25,0	11,4	5,00
beef IV	18,0	11,4	4,10