Постнова Ольга Николаевна, канд. техн. наук, доц., проф., кафедра технологии хлеба, кондитерских, макаронных изделий и пищеконцентратов, Харьковский государственный университет питания и торговли. Адрес: ул. Клочковская, 333, г. Харьков, Украина, 61051. Тел.: (057)349-45-39, 0505024584; e-mail: thkmvhk@mail.ru.

Postnova Olga, Cand. tehn. Sc. (Engineering), Associate Professor, Professor, Kharkiv State University of Food Technology and Trade. Address: Klochkovskaja str., h. 333, Kharkov, Ukraine, 61051. Tel.: (057)349-45-39, 0505024584; e-mail: thkmvhk@mail.ru.

Галич Анна Олександрівна, магістрант, кафедра технології хліба, кондитерських, макаронних виробів та харчоконцентратів, Харківський державний університет харчування та торгівлі. Адреса: вул. Целіноградська, 28, кв. 204, м. Харків, Україна, 61202. Тел.: 0997087040; e-mail: thkmvhk@mail.ru.

Галич Анна Александровна, магистрант, кафедра технологии хлеба, кондитерских, макаронных изделий и пищеконцентратов, Харьковский государственный университет питания и торговли. Адрес: ул. Целиноградская, 28, кв. 226, г. Харьков, Украина, 61202. Тел.: 0997087040; e-mail: thkmvhk@mail.ru.

Galich Anna, Student Master, Kharkiv State University of Food Technology and Trade. Address: Tselinogradskaya str., 28, flat 226, Kharkov, Ukraine, 61202. Tel.: 0997087040; e-mail: thkmvhk@mail.ru.

Рекомендовано до публікації канд. техн. наук, доц. О.Г. Шидаковою-Каменюкою, канд. техн. наук, доц. Н.В. Гревцевою.
Отримано 15.03.2015. ХДУХТ, Харків.

UDC 544.431.143:637.521

БІОЛОГІЧНА ЦІННІСТЬ ВАРЕНИХ КОВБАС, ЩО МІСТЯТЬ БАРВНИК ІЗ КРОВІ

Т.Л. Колесник, А.О. Колесник

Розроблено технологію варених ковбас, кольороформування яких здійснюється барвником з крові забійних тварин – карбоксігемоглобіном (HbCO). Використання барвника дозволило знизити в рецептурі варених ковбас вміст нітриту натрію до 1,5 г на 100 кг сировини та уникнути накопичення в готовому продукті залишкового нітриту натрію, що призводить до утворення нітрозоамінів в ковбасах, які виготовлюються за традиційною технологією. Барвник вносився в рецептуру ковбас в кількості 2% взамін м'ясної сировини. Зменшення м'ясної сировини в рецептурі викликало необхідність вивчення біологічної цінності дослідних зразків ковбас, що містили барвник з крові.

Ключові слова: *карбоксігемоглобін, варена ковбаса, нітрит натрію, біологічна цінність, лімітуюча амінокислота, амінокислотний скор, ізолейцин.*

БИОЛОГИЧЕСКАЯ ЦЕННОСТЬ ВАРЕНОЙ КОЛБАСЫ, КОТОРАЯ СОДЕРЖИТ КРАСИТЕЛЬ ИЗ КРОВИ

Т.Л. Колесник, А.А. Колесник

Разработана технология вареных колбас, цветоформирование которых осуществляется красителем из крови убойных животных – карбоксигемоглобином (HbCO). Использование красителя позволило снизить в рецептуре вареных колбас содержание нитрита натрия до 1,5 г на 100 кг сырья и избежать накопления в готовом продукте остаточного нитрита натрия, что приводит к образованию нитрозоаминов в колбасах, которые изготавливаются по традиционной технологии. Краситель вносился в рецептуру колбас в количестве 2% взамен мясного сырья. Уменьшение мясного сырья в рецептуре вызвало необходимость изучения биологической ценности опытных образцов колбас, содержащих краситель из крови.

Ключевые слова*: карбоксигемоглобин, вареная колбаса, нитрит натрия, биологическая ценность, лимитирующий аминокислота, аминокислотный скор, изолейцин.*

BIOLOGICAL VALUE OF BOILED SAUSAGE WITH BLOOD COLOURING AGENT

T. Kolesnyk, A. Kolesnyk

The technology of boiled sausage with the colouring agent from the blood of slaughtered animals – carboxyhemoglobin (NbSO) is elaborated. Carboxyhemoglobin is result of the interaction of hemoglobin with carbon monoxide and it is characterized by persistent red colour. Use of the colouring agent allows reducing in the recipe of boiled sausage of sodium nitrite to 1.5 g per 100 kg of raw material. The minimum amount of sodium nitrite in sausage forcemeat stimulates the production of the finished product without residual sodium nitrite, which leads to the formation of nitrosoamines as a result of the nitrosing reaction in sausages, which are produced by traditional technology. The colouring agent was applied into the recipe of sausages in amount of 2% instead of meat raw material. Reduction of meat raw material in the recipe necessitates the study of biological value samples of sausages which contain colouring agent from the blood.

Keywords: *carboxyhemoglobin, boiled sausage, sodium nitrite, biological value, limiting amino acids, amino-acid score, isoleucine.*

Formulation of the problem in general. The important feature of meat products, compared with other types of food products is the high

revelation of nitrosoamines in their composition. In this regard the content of volatile nitrosoamines in boiled sausage is studied, while nitrosopiperidine was in all investigated sausage samples in an amount of 0,5 ... 3,0 mg / kg.

The amount of nitrosoamines which each person consumes with food per day is calculated in the United States: 1 mg of nitrosodimethylamine and nitrosodiethylamine and 5 mg of nitrosopiperidine and all these substances are completely consumed with meat products.

International norms of low-molecular nitrosoamines tolerance are 5 – 10 mg / kg. However, these amounts are not completely safe because of the existence of additional and synergetic actions which are caused by some groups of carcinogens [1].

For the corresponding color in the production of combined meat products higher concentrations of sodium nitrite should be added in the recipe. Consequently, another problem arises. It is possible formation of nitroso amino acids, products of their decarboxylation are known as drastic carcinogens. Proline, histidine and arginine especially accelerate nitroso amino acids formation.

The above-stated necessitates the elaboration of nitrite-free technology of meat processing.

Perspective way of residual nitrite concentration in the finished product reducing is the introduction of additives which allow to reduce the nitrite content in the initial salting mixtures or those which contribute the most complete its conversion in salting process, such as organic acids with pronounced reducing properties, organic and inorganic compounds, natural and synthetic colouring agents.

Many scientific works are known where scientists recommend the replacement of synthetic colouring agents on natural colouring agents, it connects with two main factors: safety for the body because they are obtained from vegetable raw material which belongs to natural food components, and body adapted to them and prejudice of consumers against synthetic additives. Vegetable pigments such as anthocyanins, carotinoids which are contained in carrot, saffron, pepper, ginger and grapes were studied as possible color stabilizers of meat products. The researchers of our country conducted researches with use of anthocyanin colouring agents in the production of sausages and found disadvantages of such colouring agents. The main disadvantage of which is the instability of the meat products color, which is destroyed by heat, light and oxygen [2].

The classification of natural colouring agents includes animal origin pigments: blood pigment – hemoglobin and muscles pigment – myoglobin.

The problem of natural blood pigments use for meat products coloring is discussed in the literature [3].

Thus the use of natural blood pigments for meat products coloring is very important as it allows reducing or completely eliminating the use of nitrites and nitrates in the production of meat products, especially under the steady raising of the rate of replacement of meat raw material on milk and vegetable proteins which dyes badly by nitrites in combined meat products and therefore requiring the introduction of increasing doses of sodium nitrite.

Analysis of recent researches and publications. Using of blood as color forming ingredient is based on the physical and chemical and color forming properties of complex protein hemoglobin, it consists of globin protein part (96%) and prosthetic part – heme (40%), and it is major coloring substance. Red color of red blood cells depends on the presence of hemoglobin and causes their name («eritros» – red). Hemoglobin changes its color depending on the valence of iron and the nature of its bond with the protein. It is established that the iron in hemoglobin is coordinated by four nitrogen atoms of protoporphyrin IX pyrolytic rings and nitrogen atoms of imidazole ring of histidine residues, which is part of the polypeptide of hemoglobin. The possibility of colouring agent from the blood of slaughtered animals obtaining is determined by the presence in it of hemoglobin. The structure of hemoglobin can effectively coordinate oxygen, carbon monoxide, nitrogen, carbon dioxide; these compounds are able to change the properties of protein and its color. Carboxyhemoglobin (HbCO) and carboxymioglobin (MbCO) are most effective in this respect; they combine with ferroics and prevent oxidation of Fe^{2+} in Fe^{3+} of hemoglobin and myoglobin to brown color metpigment. Carboxyhemoglobin which is formed by the interaction of hemoglobin with carbon monoxide is more stable compound than oxyhemoglobin [4].

The ability of hemoglobin instantly to form strong pink compound – carboxyhemoglobin was used for elaborating of natural food colouring agent for intensification of boiled sausages color.

The purpose of the research paper. Study of biological value of the boiled sausage, colour formation of which is achieved by natural colouring agent from the blood of slaughtered animals – carboxyhemoglobin with simultaneous reduction of sodium nitrite concentration in the recipe of sausage.

The main material of the research. The technology of boiled sausages traditional color of which is achieved by the introduction to the recipe of colouring agent from blood of slaughtered animals, with reduced in five times concentration of sodium nitrite, which is introduced into sausage meat by traditional technology in quantities of 7.4 g is elaborated.

Arguments against the use of sodium nitrite connected with nitrosoamines' carcinogenicity, specifics of the technology of sausages at the stage of salting and smoking, introduction some spices further the formation of nitrosoamines and the result is the presence of residual nitrite in the sausages. Often meat products contain denitrifying bacteria which can restore the nitrates in nitrites and cause the formation of nitrosoamines. The process of amines nitrosification significantly increases under increasing of reaction time and temperature. It plays significant role in the nitrosoamines' formation in the process of cooking food products which contain nitrites. For example, increasing the length of the heating in 2 times in the sausages production increases the content of nitrosodimethylamine. Nitrosoamines formation occurs in different ways. Thus, nitrosoamines formation (nitrosopiperidine and nitrosopyrrolidine) occurs during spices such as pepper, onion, garlic storage [5].

It is found that processes of nitrates recovery to nitrites and endogenous synthesis of nitrosoamines are in human body, the presence of an acidic environment and activity of certain types of microorganisms improve this process. Since it is impossible to avoid of nitrosoamines and their precursors getting in food products and into the body it is necessary to reduce the level of nitrosing agents in food and water.

At the same time, it is known that for formation of «useful» colouring pigment nitrosomiochromogen in the sausages no more than 10% of the amount of nitrite is used. It is introduced into the product. It allows elaboration of the technology of boiled sausages with reduced amount of sodium nitrite from 7.4 g to 1.5 g per 100 kg of raw material, and the rest is replaced with colouring agent from blood of slaughtered animals. This colouring agent is treated with gaseous carbon monoxide, causing the blood pigment hemoglobin turns into carboxyhemoglobin (HbCO). It is characterized by steady red colour. Colouring agent on the base of slaughtered animals blood meets acceptable levels of natural and man-made pollution with alien substances, and also hasn't strong sensitizing properties which can cause allergy of human body, it is especially important in childhood and adolescence, because blood is familiar to human population for a long time and can not be considered as alien substance for metabolic systems of homeostasis control of internal human environment [6].

The object of the study is boiled sausage «Stolovaia» of first rate, the colorforming of which achieves by introducing of 2% carboxyhemoglobin in combination with sodium nitrite in an amount of 1,5 g per 100 kg of meat raw material. The control sample is boiled sausages «Stolovaia» of first rate which is produced in accordance with state standard of Ukraine. It contains 7,4 g of sodium nitrite in accordance with recipe. Carboxyhemoglobin was introduced into raw material during minced meat producing.

It should be noted that 2% of colouring agent is introduced as replacement of meat raw material, it allows saving of meat raw material and rational use of blood in food purposes. But in connection with the replacement of meat raw material the necessity of studying the biological value of boiled sausage with colouring agent arises.

Nutritional value of the product is determined by quantitative ratio of nutrients in it and total energy value. As food substances are sources of biologically essential substances, it is important to study the rate of biological value of boiled sausage protein with colouring agent from the blood. It is stipulated by the degree of amino acids composition balance.

Preliminarily the colouring agent amino acid composition of proteins was studied by chromatography method. The results are presented in table 1.

Table 1

Amino acid composition of blood colouring agent proteins

Amino acids	Content, g per 100 g protein	
	In the blood colouring agent	Person demand (according to FAO)
Isoleucine	0,9	3,7
Leucine	13,2	5,6
Lysine	9,7	7,5
Methionine + cystine	2,6	3,4
Phenylalanine + tyrosine	10,7	3,4
Threonine	4,8	4,4
Tryptophan	1,4	0,5
Valine	8,7	4,1

Analysis of the tables' 1 data shows that colouring agent proteins according to their amino acid composition are complete proteins and contain the full range of essential amino acids. The content of lysine in the colouring agent can satisfy the human need for this amino acid to 129,4% for leucine respectively 236%, but the content of the colouring agent protein is lack of isoleucine and sulfur-containing amino acids methionine and cystine.

The coloring agent is source of iron – its content is 30 mg% (for comparison in beef its content is 2,6 mg%) [7]. It is established that in case when heme iron is part of the food product, it is easily digested, so introduction of colouring agent in boiled sausage allows to enrich it with iron.

Amino acid composition of boiled sausage «Stolovaia» with blood colouring agent (carboxyhemoglobin) is determined by the standard method and presented in table 2.

Research of amino acid composition of boiled sausage experimental and control samples shows that the control sample which is produced by traditional technology, as limiting amino acid has amino acids sum – methionine + cystine (score 59,2). Introduction to the recipe of sausage colouring agent from blood of slaughtered animals enriches the product with all amino acids, increases the score of methionine + cystine to 62,9% because of their natural content in the blood. Exception is isoleucine, its score in the experimental sample of sausage reduces compared with the control sample of sausage on 12,5%.

Preliminary study of the residual amount of nitrite in the experimental samples of the product showed that it reduced on 93,5% compared with the control sample of sausage under complete absence of nitrosoamines. It is identified by chemiluminescence method. Mark of organoleptic indices of the experimental sausage quality was higher than the mark of control sample on 0,1 points. So isoleucine limit in the experimental sample does not significantly reduce its biological value because the daily human need in this amino acid may be covered by other products in the daily diet on the base of safety and high organoleptic characteristics of boiled sausages with coloring agent from blood.

Table 2

Amino acid composition of boiled sausage «Stolovaia» with blood colouring agent

Indices	Experimental sample		Control sample	
		AA Score, %		AA Score, %
Protein,%	4,1		13,9	
Total amount of AA (mg per 1 g of protein) including:	10371		10185	
valine	69,79	139,44	68,35	136,7
isoleucine	35,0	87,5	40,36	100,9
leucine	73,52	105,03	72,94	104,2
lysine	72,41	131,65	69,08	125,6
methionine + cystine	22,01	62,9	20,72	59,2
threonine	40,36	100,9	38,4	96,0
phenylalanine + tyrosine	70,2	117,0	67,2	112,0
Limiting AA, score, %		Isoleucine – 87,5 Methionine + cystine – 62,9		Methionine + cystine – 59,2

Conclusions. Thus, the use for coloring of boiled sausages of natural colouring agent from the blood of slaughtered animals simultaneously with low concentration of sodium nitrite allows obtaining of biologically valuable finished product, where limiting amino acid is isoleucine. Amino acid score in the experimental sample of sausage reduces compared with the control sample of sausage on 12,5%.

Список джерел інформації / References

1. Переработка и использование побочных сырьевых ресурсов мясной промышленности и охрана окружающей среды : справочник / под ред. А. Б. Лисицына. – М. : ВНИИМП, 2000. – 230 с.

Processing and use of by-product raw materials of the meat industry and the environment [Pererabotka i ispolzovanie pobochnuch sur'evukh resursov maysnoy promuschlennosti i okhrana okrugaushei sredu], Reference ed. A.B. Lisitsyna, VNIIMP, Moscow, – (2000), 230 p.

2. Спиричев В. Б. / Вопросы питания. – 2006. – № 5. – С. 45–54.

Spirichev, V.B. (2006), *Problems of nutrition [Voprosu pitaniay],* No 5, pp. 45–54.

3. Chapuy, M.K. (2004), Br. Med. G., Vol. 308, pp. 1081–1082.

4. Блажеевич Н. В. Космическая биология / Н. В. Блажеевич, В. Б. Спиричев. – 2002. – № 2. – Р. 34–40.

Blageevich, N.V., Spirichev, V.B., (2002), *Astrobiology [Kosmichna biologiay],* No 2, pp. 34–40.

5. Безнітритне виробництво ковбасних виробів: перспективи розвитку : монографія / Л. В. Молоканова, А. А. Квасніков, О. О. Орешина, Я. А. Попова. – Донецьк : Ноулідж, 2014. – 192 с.

Molokanova, L.V., Kvasnikov, A.A., Oreshyna, O.O., Popova, Ya.A. (2014), *Nitrites production of sausages: perspective of development* [*Beznitrytne vyrobnytstvo kovbasnykh vyrobiv: perspektyvy rozvytku: monohrafiia*], Nowledge, Doneck, 192 p.

6. Баженова Б. А. Формирование окраски вареных колбас с биологически активной добавкой / Б. А. Баженова, Г. Н. Амагзаева, М. Б. Данилов // Мясная индустрия. – 2011. – № 12. – С. 46–48.

Bazhenova, B.A. (2011), " Formation of color of cooked sausages with a biologically active additive" [" Formirovanie okraski varenyih kolbas s biologicheski aktivnoy dobavkoy], *Meat industy,* Vol. 11, pp. 46-48.

7. Козлова Т. А. Исследование влияния пищевых красителей природного происхождения на физико-химические свойства вареных колбасных изделий / Т. А. Козлова // Russian Journal of Agricultural and Socio-Economic Sciences. – 2012. – No. 2 (2). – pp. 34–39.

Kozlova, T.A. (2012), "Investigation of the effect of food dyes of natural origin on the physicochemical properties of cooked sausage products" [" Issledovanie vliyaniya pischevyih krasiteley prirodnogo proishozhdeniya na fiziko-himicheskie svoystva varenyih kolbasnyih izdeliy"], *Russian Journal of Agricultural and Socio-Economic Sciences*, No. 2 (2), pp. 34–39.

Колесник Тетяна Леонідівна, канд. техн. наук, кафедра товарознавства в митній справі Харківський державний університет харчування та торгівлі. Адреса: вул. Клочківська, 333, м. Харків, Україна, 61051. Тел.: (057)349-45-60; e-mail: tanytak@gmail.com.

Колесник Татьяна Леонидовна, канд. техн. наук, кафедра товароведения в таможенном деле Харьковского государственного университета питания и торговли. Адрес: ул. Клочковская, 333, г. Харьков, Украина, 61051. Тел.: (057)349-45-60; e-mail: tanytak@gmail.com.

Kolesnyk Tatiana, Candidate of Technics Sciences. Department of Customs Merchandise Expertise. Kharkiv State University of Food Technology and Trade. Address: Klochkivska str., 333, Kharkiv, Ukraine, 61051. Tel.: (057)349-45-60; e-mail: tanytak@gmail.com.

Колесник Аліна Олексіївна, канд. техн. наук, кафедра іноземних мов Харківський державний університет харчування та торгівлі. Адреса: вул. Клочківська, 333, м. Харків, Україна, 61051. Тел.: (057)349-45-69; e-mail: kafl402@mail.ru.

Колесник Алина Алексеевна, канд. техн. наук, кафедра иностранных языков, Харьковский государственный университет питания и торговли. Адрес: ул. Клочковская, 333, г. Харьков, Украина, 61051.Тел.: (057)349-45-69; e-mail: kafl402@mail.ru.

Kolesnyk Alina, Candidate of Technics Sciences, Department of Foreign Languages, Kharkiv State University of Food Technology and Trade. Address: Klochkivska str., 333, Kharkiv, Ukraine, 61051. Tel.: 349-45-69; e-mail: kafl402@mail.ru.

Рекомендовано до публікації д-ром техн. наук, проф. А.М. Одарченко.
Отримано 15.03.2015. ХДУХТ, Харків.

УДК 65.018:663.63

АКТУАЛЬНІСТЬ ВИКОРИСТАННЯ РОСЛИННОЇ СИРОВИНИ ДЛЯ ВИРОБНИЦТВА СЛАБОАЛКОГОЛЬНИХ НАПОЇВ

Н.М. Пенкіна, Л.В. Татар

Установлено доцільність використання натуральної сировини та екстрактів на її основі для виробництва слабоалкогольних напоїв. Детально розглянуто хімічний склад та антиоксидантні властивості запропонованої рослинної сировини.

Ключові слова: *сировина, бродіння, якість, екстракт, напої*