Section 3. **IMPROVEMENT OF FOOD PRODUCTS QUALITY**

**PROVISION OF DAILY NEEDS IN NUTRIENTS BY THE DIET OF DISPOSABLE CONSUMPTION OF THE THIRD GENERATION**

O. Cherevko, G. Krutovyi, G. Zaparenko, N. Galushko, A. Borysova

For the performance of the next stage of improving healthy nutrition systems, the authors suggest deficient basis for the creation of the improved diets of disposable consumption of the third generation. Eight previously projected and prepared unconventional floury products rich in such deficient nutrients as selenium, fluorine, iodine, zinc, manganese, form the basis. The named floury products are fixed for the future diets of disposable consumption of specific purpose (for the breakfasts and lunches, dinners, afternoon snacks, suppers). At the same time, diets of disposable consumption are the components of the totality of daily diets; the totality of daily diets form multiday cyclic diets of durable and improved healthy nutrition system.

The first totality of the diets of disposable consumption of the third generation for different purposes (forty-seven) is projected by means of the specified basis for the optimization of daily and cyclic diets of durable nutrition systems.

It is revealed that application of the proposed floury deficient basis for projecting diets and healthy nutrition systems promotes more complete provision of average daily needs in nutrients that influences metabolic processes of bones, and energy. It is determined that the mentioned provision of nutrients by daily diets sufficiently grows in comparison with the diets used for the creation of the nutrition systems of the first generation.

It is worth stating that it is reasonable to increase the totality of the diets of disposable consumption of the third generation 2…3 times for the considerable increase of cyclic diet or, which is the same, the number of repetition-free daily diets of the nutrition system. Such increase will promote the improvements in the solution of fundamental problems concerning balanced nutrition, other than the provision of daily needs in nutrients.

**Keywords:** floury deficient basis, diets of disposable consumption, daily diets, nutrition systems.

**RESEARCH OF STABILITY OF VEGETABLE OILS AND THEIR BLENDS WHEN FRYING POTATO CHIPS**

E. Kovalenko, V. Kovbasa, I. Radzievskaya, B. Hreben, V. Nagornyj

Potato chips is a product that requires no cooking and is ready for use as a cereal, a garnish to various dishes, snacks to beverages (juice, milk, beer, etc.). The quality of potato chips depends mainly on the quality of potatoes and frying fat, which in the chips, on average, contains 25...30%. Currently relevant topic is the increase of the nutritive value rorouni products by balancing their fatty acid composition, particularly the ratio of fatty acids of ω-6 and ω-3 family according to
the recommendations of the Ukrainian Institute of nutrition. It investigated fatty acid composition of vegetable oils (palm oil, sunflower oil, corn oil and rapeseed oil), and found that none of the oil does not comply with the balance of the fatty acid composition of the fatty acids polyunsaturated ω-6, ω-3 10: 1. To provide a balanced ratio polyunsaturated fatty acids calculated fatty acid composition of blends of vegetable oils, which is obtained by mathematical calculation represented oils, an optimal ratio of polyunsaturated fatty acids, ω-6, ω-3, which was tested as a frying fat during frying chips. For frying potato chips in various vegetable oils and their blends were created the same conditions: 70 g of potato mass, roasting temperature of 160° C and roasting duration of 220 seconds. These parameters optimal for laboratory fryer that were identified during trial testing roasting potato chips. It is found that the highest resistance observed with the mixture of palm olein, peroxide value that does not extend beyond 10 mmol ½ O / kg, for 6 hours of roasting, for a period of possible application of the oil under these conditions. The expediency of their use in the manufacture of potato chips. The magnitude of the number of peroxide elected fats that are less subject to the processes of peroxidation.

Keywords: frying fat, potato chips, fatty acid composition.
DEVELOPMENT OF PHYSIOLOGICAL MATHEMATICAL
MODEL FOR FOOD QUALITY ASSESSMENT

O. Zhulinska, K. Svidlo, L. Mostova, L. Martynenko

Modern principles of creating high-quality food products based on the selection and justification of nutria ingredients in such proportions, which would ensure achievement of the prediction quality of the finished product. It is obvious that during the design of such products one must strive to balance food composition on chemical composition. The approach of the quality management system encourages organizations to analyze customer requirements, define processes that contribute to acceptable to the consumer of the product and ensuring permanent control of these processes. The quality system should provide a mechanism of continuous improvement to increase the probability of enhancing the satisfaction of customers and other stakeholders.

Physiological model for providing a human with all required nutrients was developed due to the physiological modelling method. A mathematical evaluation of composite food quality index was made by the approximation method as Taylor series. Unit basic indices of food quality were taken as daily food allowance indices. The estimated range of acceptable values of individual quality food in the daily human diet and shown that they are small compared to the baseline. Unknown coefficients in the Taylor series were determined by calculating a derivative of the function of unit food quality indices, which was obtained by physiological mathematical modelling. The relative error of calculating the composite quality index with two terms makes 0.13% as compared to all included terms with the 8.4% deviation of the unit index from the basic one. Improved simulation of integrated quality evaluation, provides the possibility of obtaining producer of objective data on competitive shelf life of food products of functional purpose.

Keywords: modelling, food products, quality index.

THE RESEARCH OF GROWTH AND TOXIN FORMATION
OF BOTULISM BACILLI IN BOILED SAUSAGES CONTAINING
COLOR AGENT FROM BLOOD

T. Kolesnyk, A. Kolesnyk

The effects of different concentrations of sodium nitrite, color agent, and their combinations on the reproduction of the botulism causative agent in mincemeat and products of its toxin in storage conditions of the finished product are investigated.

The object of the study is sausage mincemeat of «Stolovaya» variety with addition of various concentrations of sodium nitrite and its combinations with the coloring agent and sodium sorbate. Sausage mincemeat with different concentrations of the ingredients was inoculated with spores of C. botulinum at the
rate of $10^3$ microbial bodies per 1 g. During researches the conditions of development of C. botulinum in boiled sausages were simulated. Control sample is sausage mincemeat without studied additives, which was inoculated with spores of C. botulinum, and subjected to heat treatment similar to the test samples.

It is shown that sodium nitrites have anti-botulinus activity in dependence on their concentration in the recipe of boiled sausages and storage conditions of finished products. The decreasing of sodium nitrates content to 1,5 g and its use in combination with 2% of the coloring agent does not make worse the microbiological indices of quality of boiled sausages regarding to growth and toxin formation of C. botulinum. At the same time in the sausage mincemeat with traditional concentrations of sodium nitrite (7,5–5,0 g) and in the sausage mincemeat which is recommended by us (1,5 g) in combination with the coloring agent (2%), reliable suppression of toxin formation of C. botulinum is only ensured by compliance with sanitary and hygienic requirements for storage (storage at low positive temperatures).

**Key words:** boiled sausage, botulism bacillus, toxin formation, coloring agent, sodium nitrite, sausage mincemeat, finished product, sorbate, storage conditions.

**Statement of the problem.** The coloring agent from blood of slaughtered animals (carboxyhemoglobin) is developed for the reducing the amount of sodium nitrite which is used for coloring of boiled sausages. Color formation of sausages is achieved by introducing to the recipe of coloring agent (2%) in combination with sodium nitrite in an amount of 1.5 g per 100 kg of meat raw material. The complete elimination of sodium nitrite from recipe of boiled sausages is not possible, because the sodium nitrite has antibacterial activity.

Sodium nitrite has an inhibiting effect on the development of various types of microorganisms and toxin formation, in particular, on the accumulation of ahtolotoxin. The inhibitory action of nitrites on growth and toxin formation of C. botulinum has great importance.

In connection with the above mentioned, the studies of growth and toxin formation of botulism bacillus in sausages with reduced amount of sodium nitrite are very important [1].

**Review of the latest research and publications.** The significant problem of use of nitrites in food processing industry is evaluation of their antimicrobial activity and therefore determination of the acceptability of reducing their doses in food products.

The ability of nitrites have an inhibitory effect on the development of various types of microorganisms (Salmonella, Staphylococcus aureus, fungi) and toxin formation, in particular, the accumulation of ahtolotoxin is recognized by most researchers. The inhibitory effect of nitrites on the growth and toxin formation of C. botulinum has great importance.
Different doses of nitrites, which may have an inhibitory effect on growth and toxin formation of C. botulinum and other microorganisms are pointed out (from 80 to 150 mg/kg) [2].

The effect of the residual content of sodium nitrites in model suspensions from pork during storage up to 6 months, as well as preserving additives in pasteurized meat on C. botulinum was investigated. It is shown that the residual amounts of nitrites are not directly related to the ability to inhibit the growth of C. botulinum of A and B types. The information about the existence of nonproteolytic strains of C. botulinum, which, although are more sensitive to the effects of heat, salt and nitrites, but able to grow and accumulate toxins at temperature below 10°C is particular important.

Considerable amount of researches are devoted to the use of antioxidants, since these substances delay the process of accumulation of nitrosamines through the intensification of the formation of nitric oxide and its compounding with myoglobin. Thus, it is shown that the concentration of 8-hydroxyquinoline in an amount of 1000 mg/g inhibits toxin formation within 60 days of storage at 27°C, even under the inoculation of 8000 cells/g. However, this amount of antioxidant causes the color changes of mincemeat color, but under the combination of antioxidant in an amount of 200 – 500 mg/kg and 40 – 80 mg/kg of nitrite the inhibitory effect on the growth of C. botulinum toxin formation without discoloration of the samples is marked.

Sorbic acid in an amount 0,2–0,26% to meat in combination with 40 mg/g of nitrite and 550 mg/g of ascorbic acid reduce the toxin formation of C. botulinum and microbial spoilage. Sorbitol antimicrobial effect intensifies with increasing of salt concentration from 2,5 to 3,5%, at pH value below 6,0 and at low temperature storage.

The process of introducing of ascorbic acid into the mass of mincemeat under the study of growth and toxin formation of botulinum bacillus in sausages, color formation in which is ensured by the introduction of coloring agent from the blood of slaughtered animals in combination with reduced concentration of sodium nitrite should be studied [3; 4].

In the USA method for reducing the content of residual nitrite and nitrosamines in meat while anti-botulinus action by using the mixture from salt, nitrite, polyphosphate and special additives with ascorbic acid and its salts was patented [5].

The tendency to increase the binding of nitrite with mioglobin by acidification of the medium led to the investigation of the effect of organic acids on the accumulation of nitrosamines and toxin formation of C. botulinum.

The cycle of works are devoted to the use of phosphates in the production of meat products for inhibiting the growth of C. botulinum. Sodium acid pyrophosphate in mixture with sodium nitrite effect on the
growth and toxin formation of emulsions in the beef and pork sausages; the maximum delay of toxin formation (12–18 days) is caused by combination of 0,4% sodium acid pyrophosphate, 40 mg/kg sodium nitrite and 0,26% of potassium sorbate. The authors suggest that sodium acid pyrophosphate does not effect on the spores germination, but it is effective inhibitor of toxin formation.

These properties of phosphates, we take into account for substantiation of the necessity to introduce them in the recipe of boiled sausages with the coloring agent from the blood of slaughtered animals [6; 7].

**The purpose and objective of the article** is investigation of the effects of different concentrations of sodium nitrite, color agent, and their combinations on the reproduction of the botulism causative agent in mincemeat and products of its toxin in storage conditions of the finished product.

**Presentation of the research material.** The object of the study is sausage mincemeat of «Stolovaya» variety with addition of various concentrations of sodium nitrite (30,0; 15,0; 7,5; 5,0; 1,5 g) and its combinations with the coloring agent (2%) and sodium sorbate (0,2%).

Sausage mincemeat with different concentrations of the above mentioned ingredients was inoculated with spores of C. botulinum at the rate of $10^3$ microbial bodies per 1 g.

Control sample is sausage mincemeat without studied additives, which was inoculated with spores of C. botulinum, and subjected to heat treatment similar to the test samples.

The research results which simulate conditions of development of C. botulinum in boiled sausages are presented in table 1.

Data presented in table 1 show that in the cold-storage conditions ($t = +4 \pm 1,0 \degree C$) for 3 and 5 days toxins formation of botulism bacilli is completely suppressed regardless of the content in mincemeat of the sodium nitrites, sodium sorbate, coloring agent and their combinations. The same situation is in the control non-nitrite samples.

The growth of botulism bacilli in the sausage mincemeat is observed under the same storage conditions ($+4 \pm 1\degree C$). The intensity of the growth of botulism bacilli depend on the concentration of sodium nitrite in the mincemeat.
Table 1

The growth and toxins formation of botulism bacilli in sausage mincemeat with different color-forming additives
(storage at temperature 4 ± 1° C)

<table>
<thead>
<tr>
<th>The composition of color-forming additives in the sausage mincemeat</th>
<th>Storage, three days</th>
<th>Storage, five days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Concentration</td>
<td>Growth (MPN)</td>
</tr>
<tr>
<td>NaNO₂</td>
<td>30,0</td>
<td>absent</td>
</tr>
<tr>
<td>NaNO₂</td>
<td>15,0</td>
<td>1,2×10²</td>
</tr>
<tr>
<td>NaNO₂</td>
<td>7,5</td>
<td>2,0×10¹</td>
</tr>
<tr>
<td>NaNO₂</td>
<td>5,0</td>
<td>2,0×10¹</td>
</tr>
<tr>
<td>NaNO₂</td>
<td>1,5</td>
<td>2,0×10¹</td>
</tr>
<tr>
<td>NaNO₂ + sodium sorbate 0,2% + coloring agent 2%</td>
<td>1,5</td>
<td>2,2×10¹</td>
</tr>
<tr>
<td>NaNO₂ + 2% coloring agent</td>
<td>1,5</td>
<td>2,2×10¹</td>
</tr>
<tr>
<td>Sodium sorbate 0,2% + coloring agent 2%</td>
<td>2,2×10¹</td>
<td>0</td>
</tr>
<tr>
<td>Coloring agent – 2%</td>
<td>2,2×10¹</td>
<td>0</td>
</tr>
<tr>
<td>Sausage mincemeat without additives (control sample)</td>
<td>2,2×10¹</td>
<td>0</td>
</tr>
</tbody>
</table>

It is noted that during the storage of the finished sausage mincemeat at temperature of 4° C ± 1 complete inhibition of growth of C. botulinum (MPN = 0) is observed only under the concentration of sodium nitrite 30,0 g. Sodium nitrite concentration levels of 7,5–1,5 g hardly retard the growth of C. botulinum (MPN = 2,0 × 10¹ – 2,2 × 10¹), that prove the growth indices in the control non-nitrite samples (MPN = 2,2 × 10¹).

Research results of growth and toxin formation of botulism bacilli in the sausage mincemeat which is stored after the heat treatment at temperature of 22 ± 1°C, in conditions which are not in accordance with the requirements for storage of boiled sausages (the temperature is not higher than 6°C, relative humidity in the range of 95%), for 5-days (period which
is twice as long than permissible shelf life of boiled sausages in refrigerated state) are presented in the table 2.

### Table 2

**The growth and toxins formation of botulism bacilli in sausage mincemeat with different color-forming additives (storage at temperature 22 ± 1°C)**

<table>
<thead>
<tr>
<th>The composition of color-forming additives in the sausage mincemeat</th>
<th>Storage, three days</th>
<th>Storage, five days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Growth (MPN)</td>
<td>Toxins formation (UA&lt;sub&gt;50&lt;/sub&gt;)</td>
</tr>
<tr>
<td>Name</td>
<td>Concentration</td>
<td></td>
</tr>
<tr>
<td>NaNO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>30,0</td>
<td>0,6×10&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>NaNO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>15,0</td>
<td>0,6×10&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>NaNO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>7,5</td>
<td>2,2×10&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>NaNO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>5,0</td>
<td>3,1×10&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>NaNO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>1,5</td>
<td>4,0×10&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>NaNO&lt;sub&gt;2&lt;/sub&gt; + NaNO&lt;sub&gt;2&lt;/sub&gt; + sodium sorbate 0,2% + coloring agent 2%</td>
<td>1,5</td>
<td>4,0×10&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>NaNO&lt;sub&gt;2&lt;/sub&gt; + 2% coloring agent</td>
<td>1,5</td>
<td>4,0×10&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sodium sorbate 0,2% + coloring agent 2%</td>
<td></td>
<td>4,6×10&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Coloring agent – 2%</td>
<td></td>
<td>6,8×10&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sausage mincemeat without additives (control sample)</td>
<td>6,9×10&lt;sup&gt;2&lt;/sup&gt;</td>
<td>10,0</td>
</tr>
</tbody>
</table>

Data presented in table 2 show that the growth and toxin formation of C. botulinum of A, B and E serotypes in the finished sausage mincemeat during storage at 2 ± 1°C were observed in all studied samples, in both test and control samples.

At the same time, there is definite dependence of growth intensity and toxin formation on content and the concentration of sodium nitrite:

– the maximum growth and toxin formation in control non-nitrite samples and in samples which contain coloring agent per se (MPN = 6,8×10<sup>2</sup>; UA<sub>50</sub> = 10) were observed after three days of storage at temperature of 22 ± 1°C; pronounced growth and toxin formation delay compared with control sample (НВЧ = 0,6; ΕД<sub>50</sub> = 1,72) is observed only in the samples which contain concentrations of sodium nitrite which are not
used in Ukraine during the boiled sausages production (30,0–15,0 g); growth and toxin formation of C. botulinum in sausage mincemeat containing both used concentrations of sodium nitrite (7,5–5,0 g) and recommended concentrations of sodium nitrite (1,5 g) are not significantly different among themselves by activity (for example, UA50 = 3,19 – 5,62 at UA50 = 10 in the control sample);

– the growth and toxin formation of C. botulinum in all studied sample were marked after five days of storage at temperature of 22 ± 1°C. Thus, some delay in growth and toxin formation compared with the control (non-nitrite) samples was observed in all test samples which contain nitrite.

It should be noted that the assessment of microbiological processes in boiled sausages, which are stored 5 days at temperature of 22 ± 1°C, hasn’t practical significance, since, by this time test and control products lose their necessary consumer qualities (spoilage symptoms are found out).

**Conclusions.** Thus, it is shown that sodium nitrites have anti-botulinus activity in dependence on their concentration in the recipe of boiled sausages and storage conditions of finished products.

The decreasing of sodium nitrates content to 1,5 g and its use in combination with 2% of the coloring agent does not make worse the microbiological indices of quality of boiled sausages regarding to growth and toxin formation of C. botulinum of A, B and E serotypes which vegetate in Ukraine. At the same time in the sausage mincemeat with traditional concentrations of sodium nitrite (7,5–5,0 g) and in the sausage mincemeat which is recommended by us (1,5 g) in combination with the coloring agent (2%), reliable suppression of toxin formation of C. botulinum is only ensured by compliance with sanitary and hygienic requirements for storage (storage at low positive temperatures).

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SCIENTIFIC ASPECTS OF THE METHOD FOR THE DETERMINATION OF PRESERVATIVES IN FAT-CONTAINING PRODUCTS

I. Levchuk, V. Kishchenko, V. Timchenko, E. Kunitsa, T. Arutyunyan

The present study investigates the possibility of using high performance liquid chromatography (HPLC) and capillary electrophoresis (CE) to determine mass fraction of preservatives (benzoic acid, sorbic acid and mixtures) in oil and fat emulsion products – margarines, spreads, mayonnaise. It was noted that food supplements (and, hence, and preservatives) are hazards of food quality. The conditions of sample preparation, the translation associated with the need of preservatives in water-soluble form, removing proteins that prevent the definition, and the modified starch in low-fat products. It is shown that the retention time of benzoic and sorbic acids depends on the pH of the eluting buffer. It is found that the selective separation of a mixture of these acids, which is accompanied by clear lines of the peaks in the chromatogram, is achieved at pH = 3,7–3,8. Identification of a preservative in the form of oil products is made by means of UV spectra of sorbic and benzoic acids. The measurement range of the mass fraction of preservatives in oil products by HPLC is 2–200 mg/dm³. It is recommended to use the results of this research for the development of appropriate national standard and modern schemes of technochemical control of finished products in the production of margarine and mayonnaise. It is shown that the method of capillary electrophoresis can be used to determine low concentrations of preservatives in mayonnaises and salad dressings exchange HPLC as capillary is easily restored after the starch adsorption, washing with acid and alkali, and the adsorbent column just fails. Despite some disadvantages associated with a relatively small measuring range (2–200 mg/dm³) and the complexity of the control of electroosmotic flow, to date method of capillary electrophoresis is the most promising in the study of ionic compounds. After further investigation of the sorption and ionic processes and validation techniques capillary electrophoresis can be used tehnocemkontrol oil products as a method of control of preservatives.

Keywords: food additives, preservatives, fat-containing products, high-performance liquid chromatography, capillary electrophoresis.
ANALYSIS OF CONSUMER PREFERENCES AND WAYS OF IMPROVING THE RANGE LOAVES

V. Kiyko, N. Annenkova, I. Bochko

Dry bread is made from flour and whole grain cereals. They are popular among modern consumers for fast quench of hunger and possess preventive properties. Production of these loaves is developing rapidly.

The main factors were identified based on the analysis of the consumer preferences concerning the choice of dietary loaves. This affects the decisions made by consumers.

The assortment of breads and their classification were analyzed and designed, the degree of importance of a number of consumer properties of dietary bread was determined and the ways for the improvement of their product range were developed.

People who care about their health and leading a healthy lifestyle prefer eating dry bread.

The main segment of its consumers are women and teenagers. There are some important indicators: nutritional value - 21%; taste - 20% and component parts - 18%. An important criterion is the energy value - 14%; 11% of the cost, shelf life - 7%, convenient packaging - 4%.

The research helped to identify promising areas of diversification. A composition in loaves with flour add flax seeds (cellulose) and dried cranberries berries.

New bread will increase immunity, reduce heart disease, improve bowel. Such bread can be recommended also for obese people with extra weight, for those suffering from allergies, or people with the problems of the intestinal microflora and others.

Keywords: dietetic bread, consumer properties, concentration, quality, nutritional and biological value.