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Rationality of creating a new national meat product «Meat bread»

The article considers scientifically-based selection of raw materials for obtaining a meat product with a health-promoting effect for ecologically unfavorable regions. A resource-saving production technology has been developed and the formulation of the meat product has been modeled for the prevention of diseases associated with a deficit of macronutrient and micronutrient elements, containing native animal origin proteins and a vitamins complex positively having a positive impact on the human body. Solving the problem of reduction of morbidity caused by adverse environmental situation is possible in two directions: improvement of the environment and the creation of new functional food products, making possible the correction of nutritional status, correcting adverse effect of environment. The article presents the results of the determination of functional and technological properties, amino acid composition, microbiological indices, peroxide number, and the term of product storage is determined. Such physicochemical parameters as protein, moisture, fat and sodium chloride were determined as part of the study. The microbiological analysis consisted of determining the Coliform bacteria and the number of mesophilic aerobic and facultative aerobic microorganisms.

Keywords: meat product, health-promoting effect, technology, formulation, hydrolysis of connective tissue raw material, the nutritional value, amino-acid score, pathogenic microflora, peroxide number.

Introduction

Modern requirements to a new generation of food products are to create products of high nutrition, biological value and functional orientation, taking into account the age groups of the population and their state of health. Disorders in the nutrition formula lead to negative consequences, reduce physical and mental working capacity, lead to an exacerbation of diseases.

The solution of the existing problem is possible with the organization of products branches with health-promoting effect in the RK. Current domestic products cannot be classified as health-promoting because they are high fat content, balance in the content of essential amino acids, minerals and vitamins do not meet medical and biological requirements.

In recent years, the importance of health-promoting food has increased due to scientifically grounded understanding of the importance of this direction as a therapeutic intervention in the context of the theory of healthy nutrition.

Health-promoting food should be based on physiological standards for the nutrient materials intake of a healthy man, but physiological proportions of nutrients are corrected on the basis of the diagnosis, phases of an illness and age, taking into account domestic raw materials [1].

World experience shows that the most economical and effective way of correction the nutrition and biological value of foods is to enrich them with natural nutrient additives that fill the deficit of micro-, macronutrients and serving as the antioxidants and sorbents.

The goal of research: Creation of a new meat product with the use of secondary raw materials with a health-promoting effect.

Materials and methods

Objects of research: meat raw materials (meat of beef, meat of horse meat, lung, udder), cabbage, rice, milk thistle, models for new types of products for therapeutic and prophylactic nutrition (meat bread), hydrolysis of connective tissue raw materials, prototypes of meat bread.

In accordance with the experiment, a study was made of a set of qualitative indicators and safety indicators, using standard and original methods to obtain information on the composition and properties of research objects. The following methods were used in the work.

The research was carried out on the basis of sanitary and hygienic requirements for medical-prophylactic food products based on the following indicators:

Microbiological indicators

– the number of mesophilic, aerobic and facultative-anaerobic microorganisms, coliforms pathogenic according to GOST 23392–78, GOST 21237–75. Standard methods for the study of microbiological indices in accordance with GOST 9959–81 were used in the research; GOST 10.444–85; GOST 9958–81, GOST 9225–84, GOST 10444.11–89, GOST 10444.5–85, GOST 30425, GOST RS0480–93.

Bacteriological parameters

– freshness of meat. GOST 19496–93.

Physicochemical and organoleptic indices

– pH determination. Meat products. On methodical recommendations of physical and chemical control in the meat industry. Kogan MB, Pozhariskaya LS, et al., M. 1971;

– determination of the moisture content in accordance with GOST 9793–74;

– determination of organoleptic parameters according to GOST 9959–91 meat products, GOST 7269–79 meat, GOST 9001.01.93.

Rheological indicators

– Determination of water binding capacity (WBC) by the Grau and Hamm method in the modification of VNIIMP;

– determination of structural and mechanical parameters (conditionally dynamic viscosity) on the rotational viscometer of the VRC using the VNIIMP technique.

Indicators characterizing the biological and nutritional value of the projected meat products

– determination of the protein content in accordance with GOST 25011–81;

– determination of fat content according to GOST 23042–86.

– Determination of the mineral content by the accelerated method with the use of Magnesium acetate.

– The mass concentration of calcium and phosphorus was determined by atomic absorption spectrometry.

– Amino acid composition was determined in the hydrolysates of the whole product using an automatic amino acid analyzer AAA-339.

– Determination of protein and nitrogen content by Kjeldahl. The method includes several basic steps: sampling and preparation of samples, wet ashing, stripping with steam and determination of ammonium concentration (photometrically or titrimetrically).

– The determination of the fat content was carried out by the method of Soxhlet, based on the extraction of fat from the dried sample with volatile solvents according to GOST 23042–86.

– Determination of sodium chloride was carried out according to GOST 9957–73.

– Determination of water-holding capacity (WHC), etc.

Results and discussion

During development the composition of the foods components, providing nutrition and biological value and health-promoting orientation was taken into consideration. The replacement of the main meat raw material with secondary (lung, udder) and vegetable (cabbage, milk thistle) raw materials in the formulations of meat products was provided. The use of this type of raw material, which possesses antioxidant and sorbing properties, provides a health-promoting orientation to the projected meat product.

Also, during development of the reference requirements, the requirements to the structural indicators of meat and vegetable mince were taken into account. High structural indicators are achieved both by improving technological processes (chopping, whipping, structuring), and chemical (hydrolysis of connective tissue raw materials).

Selection of raw material of meat and vegetable origin for the formulating of health-promoting food product based on the analysis of materials of scientific and technical information was conducted, taking into account the developed reference requirements

The main criteria for the selection of raw materials were nutrition and biological value, the physiological standard of intake and the health-promoting effect in cases of gastrointestinal and musculoskeletal diseases.

Preliminary preparation of connective tissue raw material

During development of a meat product containing great amount of connective tissue raw material, there is a question of its transfer to an easily digested form.

One way to achieve this goal is the hydrolysis of connective tissue raw materials (lung, udder).

The effect on the gastrointestinal mucosa, the taste of the finished product and the effect on the storage stability were taken into account when choosing the method of hydrolysis and hydrolyzing substances [2].

The acid-salt method of hydrolysis is chosen with account of these factors. In the course of research the connective tissue raw material was treated with an acid-salt mixture at various stages of its preliminary preparation in the following ways:

I. The lung and udder were blanched beforehand, then chopped with a meat grinder with the diameter of meat grinder plate 5–6 mm and treated with a hydrolyzing mixture in an amount of 1 %, 2 %, 3 % of the raw material weight. The duration of hydrolysis is 5–6 hours.

II. The raw lung and udders were chopped into pieces of 20–30 mm in size and treated with hydrolyzing mixture in an amount of 1 %, 2 %, 3 % of the raw material weight. The duration of hydrolysis is 8–10 hours.

III. The lung and udders were not treated with the hydrolyzing mixture and were taken under control.

The degree of hydrolysis was determined on the viscometer (Digital Rotational Viscometer) in terms of the index of the processed raw material viscosity. The viscosity of the processed raw materials was respectively 292; 245; 179 Pa-s.

The analysis of the obtained data allows for the conclusion about the unprincipled effect of the preliminary blanching of raw material, as the indicators of the hydrolysis degree of blanched and crude raw material slightly differ variant II was chosen for the process of hydrolysis of connective tissue raw materials.

Thus, we selected meat and vegetable raw material and component composition for the design of a new national meat product «Meat bread».

Further, we conducted a modelling of the formulation composition of a new national product with complex analytical and experimental research.

The most optimal ratio between the ingredients in the formulations was established as a result of mathematical modelling of formulations. The proposed formulations of a new type of meat product «meat bread», identified as options 1, 2, 3 are presented in Table 1.

Table 1

Modelling of the formulation composition of the «Meat bread» product

No.	Name of raw material	Content, kg to 100 kg of raw material		
		I variant	II variant	III variant
1	Beef, II grade	25.0	17.0	20.0
2	Horse beef	35.0	35.0	35.0
3	Beef lung	15.0	–	15.0
4	Udder	–	20.0	10.0
5	Far	10.0	–	7.0
6	Sunflower oil	–	12.5	–
7	Rice	5.0	5.0	5.0
8	Cabbage	5.0	7.0	5.0
9	Egg	1.0	1.0	1.0
10	Starch	3.0	1.5	1.5
11	Milk thistle	1.0	1.0	1.0
	Total	100.0	100.0	100.0
Spices kg/100 kg of mince				
1	Table edible salt	2.4	2.2	2.4
2	Caraway	0.05	0.05	0.05

Modelling of formulations was carried out taking into account physiological standards of intake and requirements of SanPiN (Sanitary Rules and Regulations) to health-promoting foods. The developed samples of product formulations are optimized optimize with respect to nutrition and biological value.

Based on the nutrition and biological value of the projected product, the following conclusions can be drawn:

– protein: fat ratio o in the developed products meets the requirements applicable to dietary and special products, and amounts — 1: 1.09;

– in amino acid composition, the developed product refers to a product with a high biological value, the amino-acid score by limiting amino acids will amount: for meat bread in I variant, 84.7 %, and in II variant — 101.6 %.

– the usage of cabbage in the formulation of meat bread in powder form provides an improvement of the functional properties of the product due to the hydrating properties of cabbage.

Based on the developed three variants of the meat bread formulations, two manufactures of prototypes were carried out in laboratory conditions.

At the stage of optimizing the meat bread formulations, the prototypes of meat bread in laboratory conditions (Table 1) were manufactured according to the components composition, the quality indicators (organoleptic, physicochemical and microbiological indicators), nutrition and biological values.

Thus, we developed samples of the formulation composition of a new national product with conduction of complex analytical and experimental research. We conducted laboratory tests with the study of the effect of the ingredients composition on the functional and technological properties of the product. Experimental research was carried out in the laboratories of S.Toraighyrov PSU. Rice; vegetables — cabbage; medical and technical raw materials — milk thistle were used as the main plant component for research

During the study of the pH value, it was established that all the prototype samples of the variants had a slightly increased level of pH value in comparison with the control one, where an intense deacidification of the mince was observed. The acidification of raw materials shows the ability to regulate this technological characteristic in a directed way, such as the selective development of microflora and its maintainin during the technological process will provide the necessary level of storage stability [3]. Comparative analysis of the results of prototypes of 1,1a, 2,2a and 3,3a variants, containing aqueous-alcoholic and aqueous infusions of milk thistle allowed to conclude that the variants of samples containing water infusions are closest to the optimal value, as these indicators show the ability to inhibit microbiological damage and exhibit antioxidant activity.

When studying the effect of plant components on water binding capacity, it was established that the level of tightly bound moisture in prototype samples was also slightly lower in comparison with the control. The content of tightly bound moisture in the control sample was 71.84, in the test samples of all variants from 68.72 to 70.37 %.

More marked dehydration of the product, by which the samples of variants 1a, 2a, 3a differ using aqueous infusions of milk thistle are best suited for further research.

Thus, maintaining the pH at 5.8–6.4 during the process will provide the required level of water retention capacity and storage stability, which goes to prove the ability to inhibit microbiological damage and exhibit antioxidant ability.

The results of microbiological studies are presented in Table 2.

Table 2

Microbiological indicators of the meat bread product depending on the term of storage

Microbiological indicator	V1			V2			V3			Admissible values according to reference documentation
	Storage time, days									
	0	2	5	0	2	5	0	2	5	
The number of mesophilic aerobic and facultative anaerobic microorganisms, CFU per 1 g of product, no more than	210	250	620	230	260	640	230	280	650	$1 \cdot 10^3$
Coliform bacteria (coliform) per 1 g of product	Not detected									Should be excluded
Pathogenic microorganisms, including salmonella in 25 g of product										
Coagulose-positive staphylococci, the number of bacteria per 1 g of product										
Sulfite-reducing clostridia, the number of bacteria in 0.01 g of product										

The conducted microscopic studies showed the conformance of the products to the requirements of the SanPiN 9958–81. From the data of the table it follows that, both in the newly produced product and in the product after 2 and 5 days of storage, the pathogenic microflora of Coliform bacteria is absent; Coagulose positive staphylococci and sulfite-reducing clostridia are also absent, and the total number of colony-forming units (CFU per 1 g of meat mass) after 2 days and 5 days of storage is normal, and corresponds to SanPiN,

therefore, the developed meat product «meat bread» is a high-quality product and it is possible to extend its term of storage up to 5 days inclusive [4].

The nature of the change of the total microbial content of meat bread during storage is shown in Figure 1.

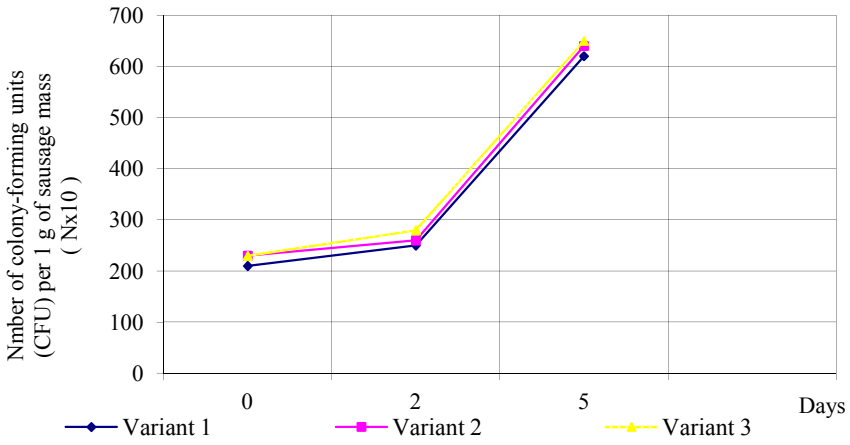

Figure 1. Dynamics of microbial content of meat bread during storage

In the experimental and control samples, the character of the change in the peroxide numbers of lipids of meat bread was studied in the course of storage. The results of the study of the kinetics of the change in peroxide numbers are presented in Table 3.

Table 3

Change in indicators of peroxide numbers of meat bread during storage

Terms of storage, days	Peroxide number (PN)			
	Control sample	Experimental samples of boiled sausages		
		Variant 1	Variant 2	Variant 3
0	0.012	0.012	0.012	0.012
3	0.016	0.013	0.014	0.014
6	0.020	0.016	0.018	0.018

Analysis of the results shows that the peroxide number of lipids of the control sample increased by 25.5 %, the experimental ones by 7, -14.3 % after 2 days of storage. When storing meat bread for 5 days, the peroxide number of lipids in the control sample increased by 40.05, while in the experimental sample it increased by 25.0–33.4 %.

The nature of the change in the peroxide numbers of lipids of meat bread during storage is presented on Figure 2.

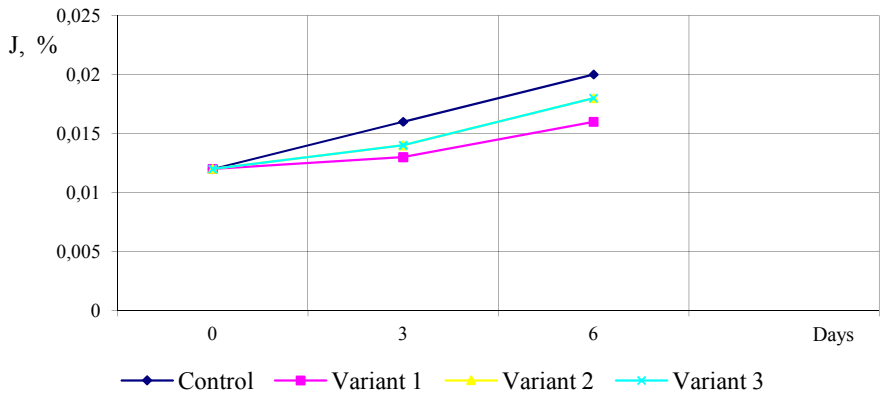

Figure 2. Change of peroxide numbers of meat bread during storage

Thus, the study of the change in peroxide numbers during the storage of meat bread showed that the peroxidation process in the control sample proceeds more intensively than in the experimental samples. The nutritional value of the developed new type of meat product and the data characterizing the degree of satisfaction with the medical and biological requirements (MBR) of the main nutrients that make up the developed product are presented in Table 4.

Table 4

Nutritional value of the developed meat product and data characterizing the degree of satisfaction with the medical and biological requirements (MBR) of the main nutrients that make up the product

Indicator	Meat bread			Content by MBR	Degree of satisfaction by MBR, %		
	B1	B2	B3		V1	V2	V3
Chemical composition, g/100g Protein	16.90	18.36	18.25	15–20	96.5	104.9	104.2
Fat	12.46	10.00	10.00	12–16	89.0	104.9	104.2
Ratio protein: fat	1:0.74	1:0.6	1:0.6	1.0:1.0±0.3	105.7	85.7	85.7
Fe	3.2	3.3	3.1	up to 7.5	–"–	–"–	–"–
Amino acids, mg/1g of protein Isoleucine	40.46	40.54	40.50	40.00	101.0	101.0	101.0
Leucine	87.80	87.20	88.30	70.00	125.0	125.0	126.0
Lysine	82.45	81.60	82.00	55.00	150.0	148.0	149.0
Methionine + cysteine	34.35	34.35	34.40	35.00	98.00	98.00	98.00
Phenylalanine +Tyrosine	75.50	75.40	75.80	60.00	126.0	125.0	126.0
Threonine	40.00	39.50	39.90	40.00	100.0	99.00	100.0
Tryptophan	11.28	11.25	11.30	10.00	112.0	112.0	113.0
Valine	53.60	53.00	53.60	50.00	107.0	106.0	107.0
The ratio of saturated to non-saturated	32.0:68.0	35.0:65.0	34.0:66.0	30.0:70.0	–"–	–"–	–"–
Caloric content, kcal/100 g	188.00	199.0	199.0	180.00	–"–	–"–	–"–

Analyzing the ratio of saturated and unsaturated fatty acids, we should note the approximation of this indicator to the recommended 30:70. The use of sunflower oil contributes to the enrichment of the product with polyunsaturated fatty acids, important in the metabolic processes of the body in violation of the function of hematopoiesis [1]. Analysis of the data of food and biological value of meat bread indicates that meat products correspond to the specificity of the population's contingent metabolism of susceptible anemia. eMineral and vitamin compositions of the developed meat product are presented in Table 5.

Table 5

Mineral and vitamin compositions of the developed meat product

Indicators	Daily requirement, kg	Meat bread		
		V1	V2	V3
Mineral substances, mg/100g				
Sodium	4000–6000	56.25	58.30	59.60
Potassium	2500–5000	286.5	299.80	297.9
Calcium	800–1000	11.9	10.4	9.7
Manganese	5–10	20.07	24.9	21.25
Phosphorus	1000–1500	197.52	218.00	206.75
Iron	15	3.18	3.30	3.23
Vitamins, mg/100g				
Thiamine (B1)	1.5–2.0	0.09	0.08	0.08
Riboflavin (B2)	2.0–2.5	0.39	0.36	0.36
Pantothenic acid (B3)	5.0–10.0	1.6	1.14	1.14
Pyridoxine (B6)	2.0–3.0	0.36	0.39	0.39
Niacin (PP)	15.0–20.0	3.04	3.18	3.18
Ascorbic acid (C)	50.0–70.0	4.6	3.3	3.3
Beta-carotene	1.5–2.5	0.29	0.10	0.10
Vitamin E (various forms)	10.0–20.0 (5.0–30.0)	4.84	3.0	9.87

The study of mineral and vitamin compositions of meat bread indicates that the formulated formulations have a sufficient content of vitamins and mineral elements (iron, potassium, calcium, etc.) due to the introduction in certain ratios of plant components (cabbage, rice cereal, milk thistle), which provides their best and effective assimilation [5]. Thus, as a result of the studies carried out, the effect of plant components on the change in the functional and technological characteristics of finished products was studied; the optimal combination of ingredients ensuring the development of new recipes for meat products, the use of raw materials of appropriate nutritional value, the optimal ratio of protein and fat, as well as high yield, quality, nutritional and biological value were revealed. The studies are confirmed by the test reports. According to the organoleptic indicators, the new meat product meets the requirements specified in Table 6.

Table 6

Organoleptic parameters of meat bread

Product name	Form	Organoleptic score, points				Overall rating
		Color on the cut	Flavor	Taste	Consistency	
Meat bread Variant 1	5.0	4.3	3.8	4.6	4.8	4.50
Meat bread Variant 2	4.6	4.3	3.5	3.8	4.8	4.20
Meat bread Variant 3	4.8	4.3	3.3	4.6	4.8	4.36

Meat product with the addition of lung with an organoleptic evaluation received 4.5 points. Lung gives the product a dark color. The product with the addition of the udder was 4.2 points, inclusions of particles were visible on the incision. When you introduce cereal rice into the meat product, the color characteristic for the meat product remains on the cut, its organoleptic score is 4.2 points. According to the «Form» indicator, the surface of the meat product was distinguished by a clean, dry surface, without damages, stains, slips, inflows of minced meat and broth-fatty edema; on the «Consistency» indicator the forcemeat is homogeneous, evenly mixed, the consistency is elastic. According to «Flavor» and «Taste» parameters, in all variants of the presented meat product samples, the flavor of spices was not sufficiently expressed and it is proposed to refine this indicator. On the basis of experimental studies and physical and chemical studies, taking into account the increase in yield and organoleptic characteristics of the studied products from the three proposed versions of the meat product recipes, the formulation of No. 2 is chosen, which most fully meets all the requirements and taking into account the improvement and elimination of existing shortcomings.

The results of our research showed that these products meet all the requirements of SanPin, do not exceed safety standards and are fully balanced products.

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«Ет наны» жаңа ұлттық өнімді жасаудың ұтымдылығы

Мақалада экологиялық қолайсыз аймақтар үшін емдік-алдын алу әсері бар ет өнімін алу мақсатында шикізаттың ғылыми-негізделген таңдауы қарастырылды. Өндірістің қор үнемдеу технологиясы құрастырылды және микро- мен макроэлементтердің жеткіліксіздігінен болатын аурулардың алдын алу үшін адам ағзасына оң ықпал тигізетін дәрумендер құрамы мен жануар текті пайдалы ақуыздары бар ет өнімнің дайындалу тәсілі үлгіленді. Қолайсыз экологиялық жағдайдан туындаған ауру-сырқаудың азаю мәселесін шешу екі бағытта жүзеге асырылады: экологиялық жағдайды жақсарту және қоршаған ортаның қолайсыз әсерін түзетіп, тағамдық дәрежені дәлдетуге мүмкіндік беретін функционалдық әсері бар азық-түліктерді жасау. Мақалада функционалдық-технологиялық қасиеттерді, аминқышқылдық құрамын, микробиологиялық қасиеттерді, тотық санын анықтаудың нәтижелері және өнімнің жарамдылық мерзімі көрсетілген. Зерттеу барысында ақуыз, ылғалдылық, май, хлорлы натрий сияқты физикалық-химиялық көрсеткіштер анықталды. Микробиологиялық талдау ішек таяқшасы тобының, мезофилді аэробты және факультативті аэробты микроағзаларды анықтауға бағытталды.

Кілт сөздер: ет өнімі, емдік-профилактикалық әсер, технология, рецептура, дәнекер ұлпалық шикізаттың гидролизі, аминқышқылды скор, патогенді микрофлора, тотығу саны.

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В статье рассмотрен научно обоснованный подбор сырья для получения мясного продукта с лечебно-профилактическим эффектом для экологически неблагоприятных регионов. Разработана ресурсосберегающая технология производства и смоделирована рецептура мясного продукта для профилактики заболеваний, связанных с дефицитом микроэлементов и макроэлементов, содержащего полноценные белки животного происхождения и комплекс витаминов, положительно влияющих на организм человека. Решение проблемы снижения заболеваемости, вызванной неблагополучной экологической обстановкой, возможно по двум направлениям: улучшение экологической обстановки и создание новых продуктов питания функционального назначения, позволяющих осуществлять коррекцию пищевого статуса, корректируя неблагоприятное воздействие окружающей среды. В статье представлены результаты определения функционально-технологических свойств, аминокислотного состава, микробиологических показателей, перекисного числа и установлен срок хранения продукта. В ходе исследования были определены такие физико-химические показатели, как белок, влага, жир, хлористый натрий. Микробиологический анализ заключался в определении бактерий группы кишечной палочки и количества мезофильных аэробных и факультативно-аэробных микроорганизмов.

Ключевые слова: мясной продукт, лечебно-профилактический эффект, технология, рецептура, гидролиз соединительно-тканного сырья, пищевая ценность, аминокислотный скор, патогенная микрофлора, перекисное число.

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