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COMPARATIVE ASSESSMENT OF THE IMPACT OF NATURAL ANTIOXIDANTS ON THE QUALITATIVE INDICATORS OF SEMI-FINISHED PRODUCTS FROM BROILER-CHICKEN MEAT AND OXIDATIVE PROCESSES IN THEIR STORAGE

Abstract. The effectiveness of use of dihydroquercetin bioflavonoid in comparison with other natural antioxidants was studied in the formulation of semi-finished products of broiler-chicken meat, indicating its high biological activity, positive impact on quality indicators, finished products yield and their consumer characteristics.

It was established that antioxidants with various efficiency inhibit the oxidative deterioration of samples primary products used in the production of semi-finished broiler-chicken products. With the introduction of vitamin E, for 28 days of storage, the acid number was lower on average by 0.84 mg KOH/g, with the addition of vitamin C, rutin and dihydroquercetin, respectively, by 1.27; 3.52 and 3.61 mg KOH/g compared with the control sample.

So, when adding tocopherol, the peroxide value in the test samples was 1.3 times lower than in the control ones. When adding ascorbic acid, rutin, and dihydroquercetin in samples of raw materials, the value of this indicator was even lower by 1.6; 1.7 and 1.9 times respectively.

As a result, after 28 days of storage of test samples of poultry processing primary products, the acid number reached smaller values by an average of 29%, and the peroxide value - by 1.5–1.7 times, in reference to the control.

The obtained results persuade of the high efficiency of using dihydroquercetin as an active antioxidant, making it possible to use it along with available analogues.

Keywords: natural antioxidants, broiler-chicken meat, poultry processing primary products, semi-finished products, quality indicators, oxidation products, storage period.

Introduction. Currently, in the meat industry, creation and production of functional products for healthy nutrition are acute. The consumption of such products helps to normalize body metabolism and improve human health [1].

It is known that meat products are not only susceptible to rapid bacteriological damage, in the fight against which preservative agents help, but also to oxidative deterioration. Oxidative processes reduce the shelf life of finished products due to the deterioration of organoleptic indicators and the nutritional value of products. Therefore, one of the modern trends in the manufacturing of meat products for healthy nutrition is an orientation towards the use of natural nutrient additives which can have a pronounced positive impact on the human body. In this regard, secure natural antioxidants deserve attention, which not only significantly inhibit oxidation process in meat products during storage, but also simultaneously serve as a primary nutrient of treatment-and-prophylactic products, that makes their use relevant in the formulation of a wide range of products [2, 3].

The aim of this research is a comparative assessment of the efficiency of natural antioxidants in semi-finished products of broiler-chicken meat during storage.

In order to achieve the aim, the following ***objectives*** were set:

1. To study the effectiveness of the inhibitory action of the studied antioxidants on the course of hydrolytic and oxidative processes in the lipid fraction of meat for processing and chilled chopped meat of semi-finished products during storage [4];

2. To determine the nature of the impact of the studied antioxidants on the main functional - technological, physicochemical and structural-mechanical indicators of the raw material of the model of minced meat of semi-finished broiler-chicken meat products [5];

3. To study the organoleptic properties of the finished products from the model minced meat of semi-finished products, made with the use of antioxidants.

Materials and methods of research. The most common types of raw materials in the production of semi-finished products are mechanically deboned meat (MDM) of broiler-chickens, fillets and skin, which contain fatty tissue in the subcutaneous tissue and, therefore, are significantly susceptible to the oxidative deterioration [5].

In this regard, there has been conducted a research on the comparative assessment of the main quality indicators of samples of poultry processing primary products and model minced meat of semi-finished products (table 1) with the addition of natural antioxidants used to reduce the formation of oxidation products during storage [7, 8].

Table 1 – Formulation of the model minced meat of semi-finished products using poultry processing primary products

	Control	Test No.1 (Vitamin E)	Test No.2 (Vitamin C)	Test No.3 (Rutin)	Test No.4 (DHQ)
Critical raw material (primary products), kg					
Broiler-chicken breast fillet, kg	60.00	60.00	60.00	60.00	60.00
MDM, kg	25.00	25.00	25.00	25.00	25.00
Skin from broiler-chicken carcasses, kg	6.00	6.00	6.00	6.00	6.00
Onion, kg	5.00	5.00	5.00	5.00	5.00
Melange, kg	4.00	4.00	4.00	4.00	4.00
Spices and materials, kg					
Food salt, kg	3.00	3.00	3.00	3.00	3.00
Ground black pepper, kg	1.00	1.00	1.00	1.00	1.00
Bread crumbs, kg	3.00	3.00	3.00	3.00	3.00
Vitamin E, kg	–	0.24	–	–	–
Vitamin C, kg	–	–	0.68	–	–
Rutin, kg	–	–	–	0.39	–
Dihydroquercetin, kg	–	–	–	–	0.72

The objects of the research were:

- "Dihydroquercetin" (DHQ), "Vitamin C", "Vitamin E", "Rutin" as antioxidant nutritional supplements [9, 10, 11, 12];
- chilled broiler-chicken meat of the 1 grade with pH24 6.2-6.5, according to GOST R 52702-2006;
- mechanically deboned chilled meat according to GOST 31490-2012;
- chilled skin from broiler-chicken carcasses.

During the research, within 4 weeks (28 days) of storage, every week it was carried out a study of test samples of primary products and model minced meat of a semi-finished product according to basic physicochemical, structural-mechanical, and functional-technological characteristics.

The investigated antioxidants were added to the homogenized samples of the raw materials in accordance with the recommendations. Their use is regulated by the Guidelines of the State Sanitary and Epidemiological Regulations of the Russian Federation No. 2.3.1.1915-04 of 2004. "Recommended consumption levels of nutrient and biologically active substances" [13], which establish an adequate

consumption level. These compounds are included in the list of food additives that do not adversely affect human health when they are used to prepare foodstuffs (Sanitary rules and regulations 2.3.2.1078-01 "Hygienic requirements for safety and nutritional value of foodstuffs").

Antioxidants were added in accordance with the recommended dosage (table 2).

Table 2 – The share of natural antioxidants in test samples

Antioxidant	Hydratation	Сырье			Model minced meat of the semi-finished products
		fillet	mechanically deboned meat	skin	
Rutin, mg/kg	1:3	0.59	0.57	0.56	0.39
Vitamin C, mg/kg	1:2	0.57	0.56	0.53	0.68
Vitamin E, mg/kg	–	0.57	0.56	0.52	0.24
Dihydroquercetin, g/kg	1:3	0.62	0.58	0.57	0.72

Preparations, apart from a vitamin E solution, were hydrated before introduction into the primary product - to facilitate more uniform distribution in it. During storage of samples at a temperature of 3±1 °C, after 7, 14, 21 and 28 days of storage, an investigation of basic physicochemical, structural-mechanical and functional-technological characteristics was carried out in 3 replications, in accordance with generally accepted standard techniques. As a result, the average values are calculated, processed by the methods of mathematical statistics.

Research results. Comparative analysis and comprehensive assessment of test samples objectively indicate the impact of natural antioxidants on changes in the studied parameters and organoleptic characteristics in research objects, but with various efficiencies (table 3).

Table 3 – The main functional and technological properties of the primary product

Samples	Control	Vitamin E	Vitamin C	Rutin	DHQ
Moisture-binding capacity, %					
Skin	48.61±0.92	52.06±0.81	53.28±0.51	56.16±0.39	56.67±0.20
MDM	52.72±0.39	55.87±0.41	56.40±0.37	57.22±0.23	58.09±0.16
Fillet	53.41±0.48	56.91±0.35	57.18±0.49	59.17±0.43	62.48±0.15
Moisture-retention capacity, %					
Skin	37.12±0.61	39.16±0.06	41.59±0.72	42.85±0.45	45.80±0.28
MDM	38.59±0.30	40.21±0.47	43.01±0.43	45.24±0.29	46.05±0.13
Fillet	40.16±0.52	42.60±0.18	45.22±0.51	48.39±0.15	50.39±0.10
Emulsifying capacity, %					
Skin	51.55±0.38	53.27±0.59	54.98±0.48	57.18±0.61	58.50±0.72
MDM	48.17±0.59	50.24±0.32	52.24±0.31	54.07±0.45	55.32±0.66
Fillet	45.15±0.18	48.19±0.48	51.60±0.16	52.18±0.94	53.71±0.41
Emulsion stability, %					
Skin	68.15±0.28	71.60±0.14	74.49±0.38	76.48±0.71	77.16±0.27
MDM	70.20±0.29	73.76±0.27	75.35±0.27	77.22±0.28	78.04±0.12
Fillet	73.49±0.15	75.05±0.38	77.92±0.18	80.14±0.93	82.69±0.52

The moisture binding capacity (MBC) of meat affects product yield, mass loss during storage, and resistance of the product in relation to the development of putrefactive microflora.

MBC is one of the most important functional properties of raw materials and characterizes the degree of bond of meat protein with immobilized and free water. MBC is determined by a number of factors: the quantitative ratio of moisture and fat, the depth of autolysis of primary product, freezing conditions, pH value, the number of proteins, their composition, and properties, including the content and degree of solubility of myofibrillar proteins with pronounced ability to swell.

The introduction of antioxidants into the primary product has ambiguously affected the change in their moisture binding capacity (MBC). If in samples with added vitamin E, vitamin C, and rutin, this indicator increased by an average of 3.37, 4.04 and 5.94%, respectively, then in samples with the added dihydroquercetin, it was even higher - by 7.50%, relating to the control sample.

The results persuade that the addition of antioxidants to raw materials has a positive effect on its moisture-binding capacity.

The introduction of antioxidants also provided an increase in the moisture-retention capacity (MRC) of the primary product. In the samples with dihydroquercetin, this indicator was higher on average by 8.79% in regard to the control, while in samples with vitamins E, C and rutin it increased by 2.03, 4.65 and 6.87%, respectively.

The improvement of such important functional and technological properties as MBC and MRC provides the improvement of a number of important sensory characteristics of the semi-finished product - its juiciness, tenderness, and contributes to an increase in the finished product yield.

The introduction of DHQ into test samples of primary products influenced the increase in their emulsifying capacity (EC), as well as the emulsion stability (ES). Unlike the control, the EC of test samples containing dihydroquercetin increases on average by 7.55%, and in the remaining samples - by 2.28, 4.65 and 6.19%, respectively.

Similarly to this indicator, improvement of the ES in all types of primary products was also noted - by 2.86, 5.31, 7.33 and 8.68%, respectively. An increase in EC and ES indicates an improvement in the functional and technological properties of the primary product, which also determines the quality of the finished product.

The impact of natural antioxidants on the chemical composition of test samples is presented in table 4.

Table 4 – The chemical composition of the test samples of primary products,% by weight of primary products

Indicators	Control	Vitamin E	Vitamin C	Rutin	DHQ
Moisture	61.90±0.33	62.68±0.92	64.78±0.89	65.73±0.56	66.52±0.62
Dry matter	38.10±0.26	37.32±0.23	35.22±0.42	34.27±0.58	33.48±1.16
Protein	25.79±0.34	25.42±0.47	23.30±0.51	22.40±1.07	21.77±0.40
Fat	10.97±0.12	10.49±0.11	10.45±0.07	10.38±0.06	10.19±0.09
Ash	1.34±0.04	1.41±0.01	1.47±0.04	1.49±0.03	1.52±0.08
Calorific capacity, kcal	204.47±0.38	198.63±0.61	189.58±0.23	185.26±0.45	180.97±0.78

When adding dihydroquercetin to the test samples of raw materials, the mass fraction of moisture increased on average by 7.46% and exceeded this indicator in other samples. The sample with the addition of vitamin E differed in the lowest moisture content, which is 1.26% higher than this indicator in the control sample since it did not contain hydrated supplements. A rise in humidity was observed in direct dependence on the level of addition of antioxidants to samples, which is associated with the hydratation of preparations. Thus, with the addition of vitamin C, the humidity of the test samples increased by 4.65%, and with the addition of rutin - by 6.19% respectively.

A gain in humidity expectedly led to a decrease in the content of dry matter in model minced meat [14].

In the dry matter of poultry processing samples, the mass fraction of ash, in relation to the control, was increased by 0.07; 0.13; 0.15 and 0.18%, respectively.

Weight fraction of fat decreased, but to a greater extent - by 0.48; 0.52; 0.59 and 0.78%, respectively.

The variations in the mass fraction of basic nutrients naturally reflected on the energy value of the semi-finished products' samples. Due to the decrease in their fat content, the calorific capacity of minced test samples containing dihydroquercetin was reduced by an average of 23.50 kcal, compared to the control, the energy value of the remaining test samples also decreased by 11.68; 14.89 and 19.21 kcal, respectively.

The results of the research have shown that the introduction of natural antioxidants had a positive impact on the viscosity and adhesion of the test samples of the poultry processing primary products, presented in tables 5 and 6.

The obtained data confirm the positive effect of antioxidants on the viscosity of the primary products. The highest value of this indicator was for samples consisting of skin from carcasses. In these samples containing vitamin E, vitamin C, and rutin, within 28 days of storage, this indicator increased on average by 6.03%; 10.60% and 17.09%, respectively, in samples with the added dihydroquercetin, it was even higher - by 19.92%, relative to the control sample.

The lowest viscosity index was in samples of fillet of broiler-chicken carcasses. During the research, it was noted the increase in this indicator in samples with vitamin E on average by 7.41%, vitamin C, rutin and dihydroquercetin - by 12.24%; 19.18% and 25.47%, respectively (table 5).

Table 5 – Variations in the viscosity of the test samples of primary products, Pa·s

Indicators	Control	Vitamin E	Vitamin C	Rutin	DHQ
At the beginning of the research					
Skin	738.50±20.69	682.33±1.78	623.67±1.47	588.33±1.78	551.00±3.94
MDM	261.12±3.69	225.33±2.86	217.67±2.48	205.67±1.78	204.67±2.86
Fillet	247.92±12.68	220.67±3.56	212.67±3.56	164.33±4.60	123.67±3.19
After 7 days of storage					
Skin	783.92±5.65	708.53±3.84	645.67±2.86	627.37±3.52	614.40±9.49
MDM	329.30±3.72	313.00±3.24	302.67±4.32	296.33±3.19	275.67±2.86
Fillet	258.42±2.28	246.33±0.82	239.67±4.02	238.67±1.47	232.33±3.19
After 14 days of storage					
Skin	839.30±11.72	795.33±10.11	773.00±5.34	681.67±13.44	673.33±13.08
MDM	397.54±5.61	347.67±3.63	332.33±8.84	318.00±1.87	302.67±4.32
Fillet	322.86±3.90	293.67±5.31	281.67±4.71	256.33±6.38	244.33±4.02
After 21 days of storage					
Skin	892.73±12.10	849.86±11.24	831.95±6.94	752.62±5.49	728.27±6.31
MDM	567.82±10.25	528.47±8.12	416.93±6.74	388.50±3.21	373.67±1.26
Fillet	412.17±9.79	389.45±7.35	361.18±6.85	342.40±4.71	329.63±2.63
After 28 days of storage					
Skin	925.38±10.34	898.52±13.49	878.31±10.66	826.74±6.02	792.12±6.79
MDM	591.76±9.68	572.30±6.02	493.28±7.25	459.17±5.06	429.48±2.83
Fillet	459.32±8.91	427.86±8.06	392.38±5.75	381.20±5.09	354.72±3.35

Studies show that the highest adhesion rate was typical for the control sample of skin, the value of which exceeded the test samples with vitamins E and C by 1.78% and 9.65%, with rutin and dihydroquetcetin - by 16.75% and 31.19 %, respectively.

Consequently, the adhesive ability of all test samples of primary products is reduced, on average, by 21.24%, that improves the rheological characteristics of semi-finished products, causing a more dense consistency of the finished product (table 6).

Comparative analysis and comprehensive assessment of the content of oxidation products in samples objectively indicate various effectiveness of the inhibitory effect of antioxidants on the oxidative deterioration of primary products (table 7).

The addition of antioxidants to the primary product samples promoted a significant inhibition of its oxidative deterioration. With adding vitamin E, the acid number for 28 days of storage was lower on average by 0.84 mg KOH/g, with the addition of vitamin C, rutin and dihydroquercetin, it was lower by 1.27 mg KOH/g; 3.52 mg KOH/g and 3.61 mg KOH/g respectively, compared with the control sample.

When studying the antioxidant activity of preparations in test samples, in parallel with the acid number, the peroxide number was also determined, which characterizes the accumulation of hydroperoxides and peroxides, which are the primary products of lipid oxidation (table 8).

Table 6 – The variation in the adhesive ability of the test samples of primary products, Pa

Indicators	Control	Vitamin E	Vitamin C	Rutin	DHQ
At the beginning of the research					
Skin	208.35±14.99	194.34±9.82	191.34±6.22	166.65±2.20	159.03±9.82
MDM	205.35±16.20	151.48±8.98	144.03±16.10	137.02±13.01	135.62±6.72
Fillet	201.35±12.41	149.76±2.46	142.21±3.21	129.26±10.67	127.62±5.41
After 7 days of storage					
Skin	201.59±9.71	178.39±6.95	166.17±11.39	155.08±11.12	152.92±2.28
MDM	189.73±9.95	175.31±5.45	158.44±14.45	153.56±7.87	143.96±4.21
Fillet	167.30±5.25	131.83±6.77	115.49±6.60	106.22±5.10	103.12±4.32
After 14 days of storage					
Skin	231.40±5.76	212.74±6.98	200.37±1.82	175.85±11.51	170.23±18.30
MDM	203.19±7.80	185.86±3.40	179.09±6.89	166.75±2.57	163.92±7.14
Fillet	181.33±3.80	147.95±7.96	137.23±1.56	123.99±4.12	110.80±5.13
After 21 days of storage					
Skin	265.61±7.30	257.71±6.49	239.03±8.64	219.83±9.64	197.51±6.14
MDM	242.64±8.23	227.97±6.95	215.17±5.15	208.78±4.32	189.65±1.63
Fillet	228.30±9.05	215.26±5.25	179.54±3.24	168.38±2.75	152.18±3.67
After 28 days of storage					
Skin	302.93±8.05	297.54±5.02	273.70±5.32	252.18±6.28	208.45±5.72
MDM	281.72±7.92	263.39±5.24	249.91±4.34	230.49±6.22	204.50±2.82
Fillet	269.87±6.50	240.16±4.27	218.68±3.17	197.75±3.40	171.83±1.28

Table 7 – Change in the acid number of samples, mg KOH/g

Indicators	Control	Vitamin E	Vitamin C	Rutin	DHQ
7 days of storage:					
Skin	0.936±0.03	0.248±0.01	0.233±0.01	0.218±0.01	0.210±0.01
MDM	0.798±0.24	0.247±0.02	0.223±0.02	0.195±0.01	0.180±0.01
Fillet	0.668±0.57	0.134±0.04	0.122±0.03	0.116±0.04	0.112±0.04
14 days of storage:					
Skin	1.028±0.03	0.820±0.01	0.743±0.03	0.603±0.01	0.530±0.01
MDM	0.839±0.10	0.572±0.44	0.443±0.02	0.395±0.01	0.348±0.07
Fillet	0.719±0.01	0.554±0.01	0.422±0.03	0.321±0.03	0.262±0.03
21 days of storage:					
Skin	2.153±0.04	1.895±0.02	1.782±0.01	1.691±0.06	1.619±0.08
MDM	1.985±0.10	1.836±0.15	1.652±0.03	1.616±0.03	1.524±0.03
Fillet	1.974±0.09	1.793±0.04	1.593±0.07	1.543±0.07	1.438±0.02
28 days of storage:					
Skin	2.542±0.02	2.389±0.01	2.125±0.07	1.925±0.04	1.705±0.04
MDM	2.306±0.06	2.194±0.05	1.897±0.03	1.803±0.04	1.694±0.03
Fillet	2.200±0.08	2.122±0.02	1.822±0.04	1.794±0.06	1.525±0.03

Table 8 – The change in peroxide number of samples, mmol (1/2O2)/kg

Indicators	Control	Vitamin E	Vitamin C	Rutin	DHQ
7 days of storage:					
Skin	2.346±0.20	0.131±0.02	0.098±0.01	0.063±0.01	0.033±0.01
MDM	2.138±0.22	0.118±0.02	0.086±0.01	0.043±0.01	0.025±0.01
Fillet	1.154±0.09	0.078±0.01	0.033±0.01	0.025±0.01	0.013±0.01
14 days of storage:					
Skin	3.459±0.09	2.911±0.12	1.443±0.06	0.903±0.08	0.473±0.08
MDM	3.038±0.72	2.708±0.59	1.141±0.34	0.808±0.08	0.360±0.19
Fillet	2.765±0.06	2.078±0.01	1.033±0.01	0.715±0.01	0.313±0.14
21 days of storage:					
Skin	4.422±0.08	4.192±0.10	3.948±0.07	3.822±0.05	3.719±0.04
MDM	4.387±0.09	4.106±0.52	3.903±0.03	3.721±0.06	3.659±0.15
Fillet	4.072±0.09	3.922±0.01	3.872±0.08	3.715±0.02	3.595±0.09
28 days of storage:					
Skin	5.620±0.03	4.368±0.09	4.232±0.03	4.152±0.09	3.870±0.02
MDM	5.494±0.09	4.284±0.06	4.162±0.03	4.091±0.03	3.829±0.05
Fillet	5.452±0.04	4.219±0.05	4.105±0.08	3.986±0.06	3.729±0.07

After 7 days of storage, in the control sample of skin from broiler-chickens, the peroxide number reached 2.3459 mmol (½O2)/kg, which exceeded the values obtained in the test samples and characterizes the sample, according to this indicator, as fresh, but not subject to storage. The introduction of antioxidants into primary product samples significantly inhibits the formation of lipid oxidation products and, consequently, that objectively testifies to the amount of peroxide number in them, which reaches lower values.

Thus, with the addition of tocopherol, this index in the test samples was 1.3 times lower compared to the control. Adding ascorbic acid, rutin, and dihydroquercetin to the samples of raw materials, the peroxide number in them was even lower - in 1.6, 1.7 and 1.9 times respectively.

The results of the organoleptic assessment are often final and decisive in determining the quality of products, especially of new types (table 8). The data of the organoleptic analysis make it possible to judge the impact of the studied factors on the quality of the products.

For the organoleptic characteristics of the investigated samples of semi-finished products from broiler-chicken meat, according to GOST 9959-91, a five-point rating scale was applied, including the main organoleptic indicators obtained by peer inspection (table 9).

Table 9 – Organoleptic indicators of the finished products (points)

Indicators	Control	Vitamin E	Vitamin C	Rutin	DHQ
Visual appearance	9.04±0.18	7.19±0.15	9.60±0.09	9.52±0.07	9.68±0.03
Smell, aroma	9.16±0.05	6.38±0.12	9.46±0.12	9.79±0.00	9.89±0.06
Taste sense	8.69±0.08	5.94±0.15	9.12±0.24	9.62±0.10	9.58±0.01
Consistence	7.47±0.14	8.24±0.20	8.75±0.20	9.15±0.07	9.42±0.05
Juiciness	5.08±0.06	7.58±0.16	8.05±0.20	9.61±0.00	9.79±0.01
Overall quality value	7.89±0.06	7.07±0.09	8.99±0.09	9.54±0.04	9.67±0.04

A degustation led the commission to the conclusion that there were significant differences in the main organoleptic indicators between the variants of the semi-finished products.

Organoleptic indicators of meat products are determined by a number of factors. The introduction of DHQ in different ways affects the quality indicators of the finished product, its taste and color characteristics, and structure.

Conclusion. The conducted studies have objectively shown that the use of antioxidants in samples of poultry processing primary products and in model minced meat of semi-finished products, in recommended dosages [8], provided for 28 days of storage lower values, relative to control, of indicators of oxidative deterioration: acid number on average by 29.42 %, and peroxide number - 1.5-1.7 times. The effectiveness of their antioxidant action was manifested in the following order: vitamin E → vitamin C → → rutin → dihydroquercetin.

The addition of DHQ to the manufacture of semi-finished products, of course, contributes to the improvement of the rheological characteristics of minced meat, thus providing a positive impact on the technological and consumer properties of the finished product.

The results of the degustation allow to judge that the samples of semi-finished products made with the addition of DHQ exceeded the control and test samples in visual appearance, color, smell, aroma, consistence, and juiciness, which indicates a positive effect of this antioxidant on most tasting indicators. And the product with vitamin E was inferior to the other samples of the semi-finished product in all its sensory characteristics.

Thus, a comparative analysis of the results showed that dihydroquercetin has the best inhibitory impact, which causes some aspects of its widespread use as an effective antioxidant during storage of poultry processing primary products.

The possibility of extensive use of dihydroquercetin in the food industry is confirmed by studies conducted at the Sechenov Moscow Medical Academy. It is established that this antioxidant is non-toxic, physiologically non-hazardous to human health, does not give products foreign flavor and smell, and does not change their color when it is used. The substance is resistant to temperature (from minus 50 to plus 180 °C), mechanical effects, and processes occurring in the manufacture of products, that is, meets all the requirements imposed in general to all nutrient additives and, in particular, to antioxidants. This is an important aspect for the consumer, and the manufacturer, at the same time, is able to make products of guaranteed quality, taking into account unforeseen technological situations.

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ТАБИҒИ АНТИОКСИДАНТТАРДЫҢ БРОЙЛЕР ТАУЫҚТАРЫНАН ЖАСАЛҒАН ЖАРТЫЛАЙ ФАБРИКАТҒА ӘСЕРІН ЖӘНЕ ОЛАРДЫ САҚТАУ КЕЗІНДЕ ТОТЫҒУ ПРОЦЕССТЕРІН САЛЫСТЫРМАЛЫ БАҒАЛАУ

Аннотация. Дихрокроцерет биохлокрекциннің басқа да табиғи антиоксиданттармен салыстырғанда қолданудың тиімділігі бройлердің тауық етінен алынған жартылай фабрикаттардың құрамында жоғары биологиялық белсенділікті, сапалық көрсеткіштерге оң әсерін, дайын өнімнің өнімділігі мен олардың тұтынушылық сипаттамаларын көрсетті.

Әртүрлі тиімділікке ие антиоксиданттар бройлер етінен жартылай фабрикаттар өндірісінде қолданылатын шикізат үлгілерінің тотығу нашарлауын тежейді.Е дәрумені енгізілгеннен кейін 28 күн сақтауға арналған қышқыл саны орташа есеппен 0,84 мг KOH / г, С, С дәруменін, рутин мен дихидроукеретинді тиісінше 1,27-ке қосқанда төмендеді; Бақылау үлгісімен салыстырғанда 3,52 және 3,61 мг KOH / г.

Осылайша, токоферол қосылған кезде сынақ үлгілеріндегі пероксидтің мәні бақылауға қарағанда 1,3 есе төмен болды.Шикізат үлгілерінде аскорбин қышқылын, рутинді және дигидрокверцетинді қосқанда, осы индикатордың мәні тиісінше 1,6; 1,7 және 1,9 есе.

Нәтижесінде, құс етін шикізатының эксперименталдық үлгілерін сақтаудың 28 күнінен кейін қышқыл саны орташа есеппен 29% -ға, асқын тотығы - 1,5-1,7 есеге дейін төмендеді.

Алынған нәтижелер белсенді антиоксидант ретінде дигидрокверцетинді қолданудың жоғары тиімділігін дәлелдейді, ол оны қолданыстағы аналогтарымен бірге пайдалануға мүмкіндік береді.

Түйін сөздер: табиғи антиоксиданттар, бройлер еті, құс етін өңдеу шикізаты, жартылай фабрикаттар, сапа сипаттамалары, тотығу өнімдері, сақтау уақыты.

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СРАВНИТЕЛЬНАЯ ОЦЕНКА ВЛИЯНИЯ ПРИРОДНЫХ АНТИОКСИДАНТОВ НА КАЧЕСТВЕННЫЕ ПОКАЗАТЕЛИ ПОЛУФАБРИКАТОВ ИЗ МЯСА ЦЫПЛЯТ-БРОЙЛЕРОВ И ОКИСЛИТЕЛЬНЫЕ ПРОЦЕССЫ ПРИ ИХ ХРАНЕНИИ

Аннотация. Изучена эффективность применения биофлавоноида дигидрокверцетина, в сравнении с другими природными антиоксидантами, в рецептуре полуфабрикатов из мяса цыплят-бройлеров, свидетельствующая о его высокой биологической активности, положительном влиянии на качественные показатели, выход готовых продуктов и их потребительские характеристики.

Установлено, что антиоксиданты с различной эффективностью ингибируют окислительную порчу образцов сырья, используемого в производстве полуфабрикатов из мяса цыплят-бройлеров. При введении витамина Е, кислотное число за 28 суток хранения оказалось меньше в среднем на 0,84 мг КОН/г, при добавлении витамина С, рутина и дигидрокверцетина, соответственно, на 1,27; 3,52 и 3,61 мг КОН/г - по сравнению с контрольным образцом.

Так, при добавлении токоферола перекисное число, в опытных образцах был меньше в 1,3 раза, по сравнению с контролем. При добавлении аскорбиновой кислоты, рутина и дигидрокверцетина в образцах сырья значение данного показателя в них оказалось еще ниже, соответственно, в 1,6; 1,7 и 1,9 раза.

В результате, через 28 суток хранения опытных образцов сырья птицепереработки, кислотное число достигло меньших значений в среднем на 29 %, а перекисное – в 1,5–1,7 раза, относительно контроля.

Полученные результаты убеждают в высокой эффективности применения дигидрокверцетина в качестве активного антиоксиданта, что обеспечивает возможность его использования наряду с имеющимися аналогами.

Ключевые слова: природные антиоксиданты, мяса цыплят-бройлеров, сырье птицепереработки, полуфабрикаты, качественные характеристики, продукты окисления, продолжительность хранения.

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REFERENCES

[1] Bobeleva G.A., Trukhina T.F. (2013). Methodical approach to determining the competitiveness of poultry products. Bird and poultry products. Moscow. № 2. P. 62-65. (in Russ.).

[2] Aniksevich O.N. (2011). Dihydroquercetin in the meat processing industry. Food industry: science and technology. Moscow. No.3 (13). Pp. 38-42. (in Russ.).

[3] Guber N.B., Rebezov M. B., Asenova B.K. (2014). Promising ways of developing meat bio products. Bulletin of the South Ural State University. Series: Food and Biotechnology. Vol. 2. No. 1. P. 72–79. (in Russ.).

[4] Fomichev Yu.P., Nikanova L.A., Lashin S.A. (2018). Dihydroquercetin and arabinogalactan - natural bioregulators used in agriculture and food industry. Bulletin of the Michurin State Agrarian University. № 3. p. 21-32. Fomichev Yu.P., Nikanova L.A., Lashin S.A. (2018). Dihydroquercetin and arabinogalactan - natural bioregulators used in agriculture and food industry. Bulletin of the Michurin State Agrarian University. № 3. p. 21-32. (in Russ.).

[5] Petrov O.Yu. (2007). On the issue of creating meat products for healthful and dietary meals. Bulletin of the Mari State University. Yoshkar-Ola. Pp. 80-82. (in Russ.).

[6] Denisovich Yu.Yu., Forozda A.V., Mandro N.M. (2012). Development of technology of enriched meat products of functional orientation. Bulletin of the Altai State Agrarian University. Gorno - Altaisk. No. 6 (92). Pp. 83-87. (in Russ.).

[7] Borozda A.V., Denisovich Yu.Yu. (2009). New aspects of the use of dihydroquercetin in the production of semi-finished meat products. Agrarian science - agriculture: proceedings of the IV Intern. scientific-practical conf. Barnaul. Pp. 25-27. (in Russ.).

[8] Krasnova O.A., Hardina E.V. (2016). The efficiency of using a complex of natural antioxidants to prevent oxidative damage to lipids of chilled meat primary products. Bulletin of the Altai State Agrarian University. Gorno - Altaisk. No. 3 (137). P. 184-187. (in Russ.).

[9] LP-003326 Alpha-Tocopherol Acetate (Vitamin E).

[10] LSR – 000043 “Askorutin”.

[11] TU 9100–241–21428156–11. (2011). Biologically active food supplement "Dihydroquercetin".

[12] TU 9197–013–95152190–11 (2011). Biologically active food supplement "Ascorbic acid".

[13] Guidelines of the State Sanitary and Epidemiological Regulation of the Russian Federation No. 2.3.1.1915-04, 2004. “Recommended consumption levels of nutrient and biologically active substances”. (in Russ.).

[14] Baimukanov D.A., Pristupa V.N., Kolosov Yu.A., Donnik I.M., Torosyan D.S., Kolosov A.Yu., Orlova O.N.,Yuldashbayev Yu.A., Chylbak-ool S.O. Improvement of breeding and productive traits of Kalmyk cattle breed. Bulletin of national academy of sciences of the Republic of Kazakhstan. Volume 1, Number 378 (2019), 128 – 145. https://doi.org/10.32014/2019.2518-1467.51 ISSN 2518-1467 (Online), ISSN 1991-3494 (Print).

[15] Sklyarov Valery, Skliarova Iouliia, Utepbergenov Irbulat, Akhmediyarova A.T., et al. (**2019**) // International journal of innovative computing information and control. Vol. 15. Issue 1. P. 321-335.

[16] Pertiwi D., Sudrajat A., Kumalasari D., Retnawati H., Waspada S.P., Dossayeva S.K., Kassymova G.K. (**2019**). Gender equality in feminism // Bulletin of National academy of sciences of the Republic of Kazakhstan. ISSN 1991-3494. Vol. 5(381). P. 112-121. https://doi.org/10.32014/2019.2518-1467.130