Effectiveness of natural antioxidants on oxidizing processes at storage of the raw materials containing collagen of bird processing

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Abstract. The purpose of researches is comparative assessment of effectiveness of effect of natural antioxidants at storage of raw materials of the poultry processing industry. For achievement of a goal addition of antioxidants is provided in control specimens. The experimental data are obtained as a result of carrying out laboratory researches on definition of acid and peroxide numbers in raw materials of the poultry processing industry in 7, 14, 21 and 28 days of storage. Antioxidants with various effectiveness promoted decrease in extent of their oxidizing decay. Addition of antioxidants in test pieces of raw materials promoted essential braking of its oxidizing decay. At reproduction vitamin introduction, acid number in 28 days of storage turned out less on average on 0.84 mg KOH /g, at addition of redoxon, Rutinum and dihydroquercetinum, respectively, on 1.27; 3.52 and 3.61 mg KOH /g - in comparison with a control specimen. So, at tocopherol addition this index in test pieces was 1.3 times less, in comparison with monitoring. As a result, in 28 days of storage of test pieces, acid number reached smaller values on average for 29%, and peroxide – by 1.5÷1.7 times, concerning control specimen. The received results convince of high performance of use of dihydroquercetin as the fissile antioxidant that provides a possibility of its use along with the available analogs.

1. Introduction
Now in the meat industry creation and production of the products of the functional orientation intended for a healthy delivery is relevant. Consumption of such products allows to stabilize a metabolism in an organism and to improve the state of health of the person [1].

It is known that meat products are subject not only fast microbiological decay preservatives, but also oxidizing help with fight against which. Oxidizing processes reduce a period of validity of finished goods due to deterioration in organoleptic indexes (change of appearance, a smell, taste of a product) and nutrition value of products. Consumption of the products containing the oxidized fats and products of their metabolism is extremely dangerous as the radicals which are contained in the oxidized fat phase contribute to the development of a chain reaction of oxidation in organism cages, and secondary metabolites of oxidation of fats (a malonic dialdehyde, ketones) can lead to development of an obesity, diseases of a liver and heart [2]. Therefore, the used for control of oxidizing processes in meat products, especially with the high content of fat, various antioxidants interrupt autoxidation reaction which results from contact of nutrients with air oxygen. However, the
majority of the modern antioxidants of synthetic origin and their action on a human body is studied insufficiently that leads to ambiguous consequences, and also their application is inexpedient as the organism has the antioxidatic system. In an organism this function is performed by enzymes (a catalase, superoxide dismutase, peroxidase, glutathione peroxidase, ubiquinone), an albumin and some other proteins, including sulfur-containing and selenosoderzhashchy, lipoproteins of high density, steroid hormones, bilirubin, uric acid [3]. These substances are helped by exogenous antioxidants - vitamins which come to an organism with food. Therefore one of the modern trends in the field of production of meat products of a healthy delivery – orientation to use of natural nutritional supplements which are capable to make the expressed positive impact on a human body. In this regard, attentions safe natural antioxidants-antioxidants which not only considerably slow down oxidation in meat products in the course of storage deserve, but also at the same time serve as the operating beginning of products of treatment-and-prophylactic appointment that does relevant their application in compounding of a wide range of products [4].

Dihydroquercetinum – the natural connection allocated from wood of the Siberian larch is recognized as one of the activest antioxidants of natural origin applied by production of foodstuff [5]. Digidrokvertsetin has the highest antioxidatic activity. Antioxidatic activity - the index reflecting ability to inactivate the free radicals of oxygen. The antioxidatic activity of dihydroquercetinum is shown at its concentration $10^{-4} \div 10^{-5}$. It is the least concentration of substance with antioxidatic activity in comparison with all known exogenetic antioxidants, including reproduction vitamins, A, B, C, D, K, β-Carotinum. Nevertheless, use of natural antioxidants by production of meat products, is caused by emergence of particular difficulties at stages of technological process. Vitamins-antioxidants of natural origin easily lose the activity and their structure under the influence of various factors collapses: contact with a metal surface, influence of open sunshine and oxygen of air, high-temperature processing (an exception vitamins A, E, K and carotenoids are) [6, 7]. With the researchers conducted in the Moscow Medical Academy of I.M. Sechenov it is confirmed that dihydroquercetinum is nontoxic, physiologically harmless to health of the person, does not give to products of strangers of smack and a smell, does not change their color at its use. Additive is steady in relation to temperature (from minus 50 to plus 180°C), to mechanical influences, and the processes taking place at manufacture of products that is meets all requirements imposed in general to all nutritional supplements and, in particular, to antioxidants. This connection is included in the list of the nutritional supplements which are not making harmful effects on health of the person when using for preparation of foodstuff (the SanPiN 2.3.2.1078-01 "Hygienic requirements to safety and nutrition value of foodstuff") [8].

2. Experimental part

Comparative researches of the most widespread natural antioxidants on their ability to inhibit formation of oxidates of lipide fraction in test pieces of raw materials, widely applicable in production of products from fowl were conducted. As evaluation criteria served change in exemplars of the acid and peroxide numbers testifying to extent of oxidizing decay of raw materials.

The pilot studies were conducted within 28 days of storage of exemplars in the cooled state at a temperature of $3\pm1$°C.

According to a goal, objects of experiments were:

- as antioxidants – "Digidrokvertsetin", "Acidum ascorbinicum", "Tocopherol" and "Rutinum";
- fillet of chilled carcasses of broilers with pH₄₄ 6.2 ± 6.5, in accordance with GOST P 52702-2006;
- meat of broilers of a mechanical boning (MMO) in accordance with GOST 31490-2012;
- skin from carcasses of broilers.

Use of these antioxidants is regulated by the Methodical recommendations of the State sanitary and epidemiologic rationing of the Russian Federation no. 2.3.1.1915-04 of 2004. "The recommended
consumption levels food and biologically the active materials”

Antioxidatic medicines, except for reproduction vitamin, for more smooth distribution in raw materials, before an importation subjected hydrations. In 7, 14, 21 and 28 days of storage of exemplars, it was carried out, in 3-fold frequency, determination of content of oxidates, in control and test pieces, on acid and peroxide numbers, according to the reference practical standards. All received results are processed by methods of mathematical statistics.

3. Results and Considerations

The comparative analysis and complex assessment of content of oxidants in exemplars objective confirm different effectiveness of the inhibiting effect of antioxidants on oxidizing decay of raw materials (table 1).

| Raw materials | Control | Vitamin E | Vitamin C | Rutinum | 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 |
| MMO           | 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 |
| MMO           | 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 |
| MMO           | 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 |
| MMO           | 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 |

Addition of antioxidants in test pieces of raw materials promoted essential braking of its oxidizing decay. At reproduction vitamin introduction, acid number in 28 days of storage turned out less on average on 0.84 mg KOH /g, at addition of redox on, Rutinum and dihydroquercetinum, respectively, on 1.27; 3.52 and 3.61 mg KOH /g - in comparison with a control specimen.

When studying antioxidative activity of medicines in test pieces, in parallel with acid number, the peroxide value characterizing accumulation of hydroperoxides and peroxide compounds which are primary oxidants of lipids (table 2) was defined.

More narrow in 7 days of storage of raw materials, in a control specimen of skin from carcasses of broilers, peroxide value reached 2.3459 mmol (% O2)/kg that exceeded the values received in test pieces and characterizes an exemplar, on this index as fresh, but not subject to storage. Introduction of antioxidants, in raw materials test pieces, significantly slows down formation of oxidants of lipids and, therefore, what the size of peroxide value in them which reaches smaller values objective testifies to.

Addition of Acidum ascorbinicum, Rutinum and dihydroquercetinum in raw materials exemplars peroxide value in them was even lower - respectively in 1.6, 1.7 and 1.9 times.
4. Conclusion

Introduction of antioxidants to raw materials test pieces in the studied concentration provided, within 28 days of storage, smaller value of indexes of oxidizing decay: acid number on average for 29.42%, and peroxide value – by 1.5 ÷ 1.7 times, concerning these indexes in a control specimen.

Thus, the comparative analysis of the received results showed that dihydroquercetinum possesses the best inhibiting action that causes aspects of its broad application as efficient is antioxidatic at storage of meat raw materials of the poultry processing industry.

The possibility of wide use of dihydroquercetinum in the food industry is confirmed by the researchers conducted in the Moscow Medical Academy of I.M. Sechenov. It is established that this antioxidant is nontoxical, physiologically harmless to health of the person, does not give to products of strangers of smack and a smell, does not change their color at its use. Substance is steady in relation to temperature (from minus 50 to plus 180 °C), to mechanical influences, and the processes happening at manufacture of products that is meets all requirements imposed in general to all nutritional supplements and, in particular, to antioxidants. It is important aspect for the consumer, and the producer, at the same time, has an opportunity to develop production of the guaranteed quality taking into account unexpected technological situations.

Table 2. Change of peroxide value of exemplars, mmol (½O₂)/kg.

| Raw materials | Control | Vitamin E | Vitamin C | Rutinum | 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 |
| MMO          | 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 |
| MMO          | 3.038±0.72 | 2.708±0.59 | 1.141±0.34 | 0.838±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 |
| MMO          | 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 |
| MMO          | 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 |

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