AMETIS, closed Joint-Stock Company

DIHYDROQUECETIN
in Meat, Poultry and Fishing Industries

The application of Dihydroquercetin in the food industry is regulated by the following normative documentations in the Russian Federation:

- According to the Decision of the State Chief Medical Officer dated November 14, 2001 No 36 "About the application of the Sanitary and Epidemiological Conclusion (SEC) 2.3.2.1078-01", dihydroquercetin is classified as an antioxidant;
- The Decision of the State Chief Medical Officer dated April 18, 2003 No 59 "About the application of SEC 2.3.2.1293-03" allows using dihydroquercetin for manufacturing of cream, chocolate, dry milk. The maximal content of Dihydroquercetin in these products is 200 mg/kg fat of the product;
- The Methodical Recommendations of the State Sanitary and Epidemiological Regulations No 2.3.1.1915-04 "Recommended norm of consumption of food and bioactive supplements" has determined the appropriate and the highest allowable level of Dihydroquercetin consumption: 25-100 mg per a day;
- GOST R 52791-2007. Canned milk. Dry milk. Specifications. Date of introduction: January 1, 2009;
- GOST R 53436-2009. Canned milk. Milk and cream sweetened condensed. Specifications. Date of introduction: January 1, 2011.

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The Material prepared by Ametis JSC

BRIEFLY ABOUT DIHYDROQUERCETIN

Main Properties of Dihydroquercetin

1) Antioxidant properties

Dihydroquercetin is an antioxidant of direct action which binds free radicals. Dihydroquercetin inhibits free radical oxidation of both water soluble (luminol, ABTS) and fat-soluble substrates. dihydroquercetin as antioxidant could function as (1) the "catcher" of active forms of oxygen, (2) chelator of metal with variable valency, (3) chainformative agent.

2) Capillary-protective properties

Dihydroquercetin decreases the pathological capillary fragility and increases the resistance of normal capillaries to trauma. Dihydroquercetin tends to maintain the normal tensile strength of capillary walls.

3) Anti-inflammatory properties

Dihydroquercetin reduces capillary permeability, inhibits action of many enzyme systems involved in the development of inflammation and allergy, reduces release of histamine and other mediators of inflammation from mast cells and basophils, limits action of kinins and anti-inflammatory prostaglandins to tissues.

4) Radioprotective properties

Dihydroquercetin slows the development of free radical oxidation, decreases lipid peroxidation activity induced by gamma irradiation. Some studies reveal the possible use of dihydroquercetin as pharmaceutical to defend the human organism from a lipid peroxidation effects which are activated under various pathologic conditions including general irradiation by gamma rays.

5) Detoxifying properties

Detoxifying properties of Dihydroquercetin are related to the direct interaction with toxins. Dihydroquercetin binds toxins into a stable form with the subsequent excretion from the organism.

6) Hepatoprotective properties

Dihydroquercetin has the positive effect on the liver function: normalizes the cell membrane and the structure of hepatocytes, has an antioxidant effect, accelerates the regeneration of damaged liver parenchyma, thereby enhances its detoxifying function.

Dihydroquercetin is the natural antioxidant of plant origin, bioflavonoid. Dihydroquercetin as an ingredient of phenolic compounds is found in many kinds of herbs and shrubs, but only in several kinds of trees dihydroquercetin is found to a greater extend. Dihydroquercetin, produced by Ametis JSC under the trade mark **"Lavitol",** is a flavonoid, derived from Dahurian Larch (Larix gmelinii) by a water-ethanol extraction method.

Dihydroquercetin extract is an active antioxidant that could slow down oxidative reactions. The level of antioxidative activity allows to put dihydroquercetin on the first positions among the substances with similar spectrum of action.

The use of Dihydroquercetin in food products is determined by its ability to reduce oxidative reactions and to strengthen capillaries. Utilization of these properties can be beneficial in **two directions:**

a) as an antioxidant, Dihydroquercetin can reduce lipid peroxidation, with the consequent prolongation of food products' shelf life; and

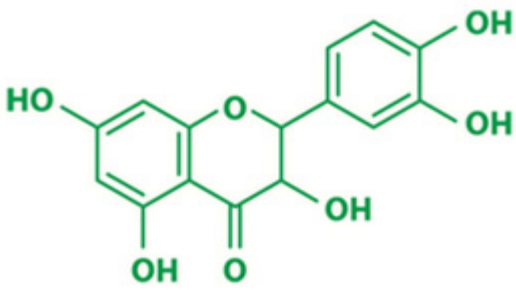
b) because of its capillary-strengthening properties, Dihydroquercetin can be used for functional products that are aimed at enhancing health.

In the food industry, Dihydroquercetin is used in dairy products, meat products, alcoholic and non-alcoholic beverages, confectionary products, and products of functional nutrition.

The application of dihydroquercetin in food industry is caused by its ability to reduce the lipid peroxidation, with the prolongation of food products' shelf life in 1.5 – 4 times.

The lipid oxidation of food products leads to a deterioration of organoleptic characteristics, loss in nutritional value, color changes, microbial contamination, etc. Dihydroquercetin can improve the biological value of food products and retain the original organoleptic properties for a long time.

Dihydroquercetin slows down the oxidation processes not only in products, fortified with Dihydroquercetin, but also in human organism. The presence of even small amounts of Dihydroquercetin in the parapharmaceutical food prevents a number of diseases associated with the so-called "oxidative stress" and also helps to protect the body against free radicals.



APPLICATION OF DIHYDROQUERCETIN

Use of Dihydroquercetin (DHQ) in meat products

1) Extends the shelf life

Dihydroquercetin increases the shelf life of food products in 1.5 - 3 times, inhibiting oxidation reactions of food compounds. Dihydroquercetin suppresses the growth of microorganisms in foods, which have been already exposed to the oxidation process.

2) Increases the biological value

Lipids of meat products are vulnerable to free radical oxidation during processing and storage, leading to decreased quality and loss of nutritional value. In addition, oxidized lipids affect the toxicological and microbiological safety of dairy products, and their consumption may cause the occurrence of pathological changes in the body. As an antioxidant dihydroquercetin promotes the inhibition of lipid peroxidation that not only increases the shelf life but also the nutritional value of products.

3) Preserves the original organoleptic characteristics during storage

Lipid oxidation of food products leads to deterioration of organoleptic characteristics, loss in nutritional value, changes in appearance, etc. Dihydroquercetin preserves the initial organoleptic qualities of food products.

4) Enrichment of food products with antioxidants

Processing of food causing loss of many natural oxidants presented in raw materials, making the final product less resistant to the oxidation process.
Fortification of food products with dihydroquercetin promotes not only to supply with antioxidants, but also to slow down the oxidation process.

5) Supplies the product with parapharmaceutical properties

It is well known that end-products of lipid peroxidation may be mutagenic and cancerogenic, the most dangerous of them are free-radicals. Dihydroquercetin is the substance which “catches” and binds free radicals, preventing thereby the development of pathogenic processes and cell membranes lipid peroxidation.

6) Natural antioxidant

Dihydroquercetin is bioflavonoid extracted from natural plant raw material - Dahurian larch wood. Numerous studies have confirmed that Dihydroquercetin is non-toxic, physiologically harmless product for human.

APPLICATION OF DIHYDROQUERCETIN

The Efficiency of Dihydroquercetin in Meat, Poultry and Fishing Industries

Ground pork

- The addition of 0.001% Dihydroquercetin to ground pork (stored during 7 days at a temperature +4 °C and 14 days a a temperature -18 °C) leads to a significant inhibition of the oxidation process. Dihydroquercetin inhibits the peroxide values by 13.8%, 20.8%, 57.1% during the 3, 5, 7 days, respectively, compared to control *(Gurinovich, G.V., Lisin, K.V., et al., 2005).*
- Fortification of ground pork with Dihydroquercetin inhibits the formation of free radicals at the early stage of storage. The amount of peroxides in the fat fraction remains at an acceptable level even when the shelf life increased by 7 times of the standard shelf life *(Gurinovich, G.V., Lisin, K.V., et al., 2005).*

Ground chicken

- Fortification of **ground meat made from mechanically deboned chicken** and stored at -8 °C for 45 days with 0.006% and 0.02% by meat mass Dihydroquercetin significantly decreased the acidity value of the tested samples6 resulted in an increase in shelf life up to one month, at 0.06% by fat mass resulted in an increase in shelf life up to 45 days (*Potipayeva, N.N., 2005*).
- Fortification of **ground chicken** stored at -18 °C for 30 days with Dihydroquercetin in a 40%-alcohol solution resulted in a significant decrease of peroxide value. The primary products of oxidation accumulated more intensely in the control samples than in the test samples *(Borozda, A.V., Denisovich, Yu., Yu., 2009).*
- Fortification of **ground meat made from mechanically deboned chicken** and stored at -18 °C for 6 months with Dihydroquercetin significantly decreased peroxide value. The addition of Dihydroquercetin decreased the peroxide value by 2.6-3.0 times as compared to the control. The oxidation process in the sample with Dihydroquercetin was 52% slower than in the control *(Denisovich, Yu. Yu., 2006).*
- Fortification of **ground chicken** made from mechanically deboned chicken and stored at – 18 °C for 6 months with Dihydroquercetin at 0.025% per raw mass resulted in no significant changes in microbiological indices. By the end of the storage period, the amount of MAFAnM in ground chicken disinfected and fortified with Dihydroquercetin was lower than that in control, in which the microbial growth was observed after 4 months of storage *(Denisovich, Yu. Yu., 2006).*

The Influence of Dihydroquercetin on Microbiological Indices

L. monolcyto-genes	Dihydroquercetin inhibits the growth of L.monoclyto-genes in sterilized sour cream. It kills on average **30%** of L.monocytogene
E.coli	Dihydroquercetin inhibits the growth of E.coli in sterilized sour cream. It kills on average **12%** of E.coli
S.aureus	Dihydroquercetin inhibits the growth of Staphylococcus aureus It killed on average **90%** of Staphylococcus aureus
Lipolytic microorganisms	Fortification with Dihydroquercetin inhibits the growth of lipolytic microorganisms in milk fat, inhibits significantly their growth in sterilized cream. It kills on average **44%** of lipolytic microorganisms in sterilized cream and **88%** - in tallow.
Rhodototorula yeasts	**0.014 mg** of Dihydroquercetin is required for complete inhibition of 1 CFU of Rhodototorula
Lactic acid bacteria	**0.011 mg** of Dihydroquercetin is required for complete inhibition of 1 CFU of Lactic acid bacteria
Alicyclobacillus acidoterrestris	**2.5 mg** of Dihydroquercetin is required for complete inhibition of 1 CFU of Alicyclobacillus acidoterrestris

Ground beef

- Dihydroquercetin, added at 0.025%, 0.050%, and 0.075% by raw material mass in a 40%-alcohol solution to beef decreased the acidic value and the levels of peroxide values of **ground beef** stored at -18 °C for 30 days. At 0.050% DHQ and 0.075% DHQ, the levels of acidic value were 6.5% lower than in the control samples. At 0.050% DHQ, the peroxide values were 10%, 13%, and 16% lower than those of the control on the 1st, 15th and the 30th day, respectively *(Mandro, N.M., Borozda, A.V., et al., 2009).*
- Enriched with Dihydroquercetin **ground beef** preserved its organoleptic properties (appearance, color, succulence) after 30 days of storage at -18 °C *(Mandro, N.M., Borozda, A.V., et al., 2009).*

APPLICATION OF DIHYDROQUERCETIN

Raw meat

- Fortification of **beef, pork and poultry** stored at 4 °C for 7 days with Dihydroquercetin significantly decreases the rate of accumulation of primary oxidation products as was measured by peroxide value *(Krasnova, O.A., Shakhova, E.V, 2008).*
- After fortification of **beef, pork and poultry** stored at 4 °C for 7 days with Dihydroquercetin, 80% of the fortified samples preserved its original odor, color, and consistency *(Krasnova, O.A., Shakhova, E.V., 2008).*
- On the 3rd and 5th days of storage at 4 °C, 80% of **raw meat samples (beef, pork, poultry)** fortified with Dihydroquercetin have only single colonies of staphylococcus, diplococcus and sarcin (up to 10 cells), on the 7th day the number of microorganisms was insignificantly changes *(Krasnova, O.A., Shakhova, E.V., 2008).*

Sausages

- Fortification with Dihydroquercetin at 0.006% by lipid mass resulted in a decrease in accumulation of peroxides, free fatty acids in **semi-smoked sausages** stored for one month *(Nasonova, V.V., 2008).*
- Fortification with Dihydroquercetin at 0.006% by lipid mass improved organoleptic indices and decreased the quantity of microbial contamination at the surface of lipid droplets, which can be related to a bacteriostatic activity of Dihydroquercetin in **semi-smoked sausages** stored for one month *(Nasonova, V.V., 2008).*
- Dihydroquercetin increased the resistance to oxidative damage, preserved the density of structural elements of **semi-smoked sausages** for a longer period of time *(Semenova, A.A., Nasonova, V.V., 2011).*
- Fortification with Dihydroquercetin reduced the number of microorganisms on the surface of fat droplets of **semi-smoked sausages** *(Semenova, A.A., Nasonova, V.V., 2011).*

Semi-Finished Products

- Fortification with 0.01% Dihydroquercetin inhibited lipid peroxidation and accumulation of secondary oxidation products in **shish-kebab made from pork** stored at -18 °C for 70 days. By the 70th day, the peroxide value of the experimental sample reached the peroxide value of the control sample observed on the 30th day of storage. At the 70th day of storage, the peroxide value of the control sample was 2.7 times higher than that in the experimental sample. An increase in the MDA value was observed on the 10th day of storage in the control sample and on the 50th day of storage in the experimental sample. The level of MDA in the experimental sample on the 70th day of storage was equivalent to the MDA value in the control sample observed on the 30th day of storage *(Moshchevikina, O.N., 2009).*
- Fortification with 0.01% Dihydroquercetin decreased the levels of microbiological contamination in **shish-kebab made from pork** stored at -18 °C for 70 days. The level of microbial contaminants reached $5.0x10^4$ CFU/g in the control sample and $1.7x10^4$ CFU/g in the experimental sample *(Moshchevikina, O.N., 2009).*
- Fortification with 0.003% and 0.006% by raw weight Dihydroquercetin as a 1%-solution on the basis of a 40%-alcohol solution lowered the rate of accumulation of secondary oxidation products in a lipid fraction of **dumplings (15.1% fat)** stored at -8 °C for 35 days. The TBA value in the sample with 0.003% DHQ was 66% and in the sample with 0.006% Dihydroquercetin was 45.8% lower vs. the control. Addition of dihydroquercetin resulted also in a slower hydrolysis rate (the acidity value was 30% lower than in the control sample) *(Potipayeva, N.N., 2006).*
- Fortification with Dihydroquercetin at 0.05-0.075% by raw weight inhibited decomposition of primary lipids in meat systems and prolonged the shelf life of **meat semi-finished products** made from poultry and roe meat *(Mandro, N.V., Borozda, A.V., et al., 2008).*
- Fortification with Dihydroquercetin at 0.02% by lipid mass preserved Vitamin E and carotenoids in the **minced semi-finished products** made of red or white meat *(Gonotskiy, V.A., Dubrovskaya, V.I., 2011).*
- Fortification with Dihydroquercetin at 0.02% by lipid mass inhibited the formation of carbonyl compounds in the **minced semi-finished products** made of poultry *(Gonotskiy, V.A., Dubrovskaya, V.I., 2011).*
- Dihydroquercetin preserved the qualitative indices of **minced semi-finished products** made from poultry and increased the shelf life in 7 times *(Gonotskiy, V.A., Dubrovskaya, V.I., 2011).*

APPLICATION OF DIHYDROQUERCETIN

Mechanically deboned chicken

- Fortification with Dihydroquercetin at 0.02%, 0.04%, and 0.06% by lipid mass of mechanically deboned chicken (15% fat content) stored at - 18±2 °C for 50 days significantly decreased the accumulation of free fatty acids. The level of acidic values in the enriched samples did not exceed the normative values at the end of the storage period *(Nasonova, V.V., 2008).*
- Fortification with Dihydroquercetin at 0.02%, 0.04%, and 0.06% by lipid mass of mechanically deboned chicken (15% fat content) stored at - 18±2 °C for 50 days significantly enhanced color stability of the product *(Nasonova, V.V., 2008).*

Seafood Products

-Fortification with 0.001% Dihydroquercetin in a 1% ethanol solution lowered peroxide values in **fish (halibut, herring)** after 7 days of storage at 2-4 °C. The accumulation of primary oxidation products was in 4.2 times less in Dihydroquercetin-fortified samples than in the controls *(Krasnova, O.A., Shakhova, E.V., 2008).*

- Fortification with 0.001% dihydroquercetin in a 1% ethanol solution preserved the organoleptic indices in **fish (halibut, herring)**. Samples without Dihydroquercetin showed deterioration of organoleptic properties on the 3rd day of storage; these changes were especially pronounced on the 5th and 7th days. Dihydroquercetin-fortified samples preserved their initial organoleptic properties. Some changes in color and consistency were observed by the 7th day *(Krasnova, O.A., Shakhova, E.V., 2008).*
- 0.001% Dihydroquercetin in a 1% ethanol solution displayed antimicrobial properties in fish (halibut, herring) after 7 days of storage at 2-4 °C. In samples without Dihydroquercetin, a significant increase in microbes was observed on the 3rd, 5th and 7th days of the storage. In Dihydroquercetin-fortified samples, only singular growth of staphylococcus, diplococcus, and sartcin (up to 10 cells) was observed *(Krasnova, O.A., Shakhova, E.V., 2008).*
- Fortification with Dihydroquercetin [superficial treatment] increased the shelf life of **chilled trout** up to 7 days (4 days longer compared with controls). Fortification with Dihydroquercetin in a mixture with ascorbic acid increased the shelf life of chilled trout up to 10 days (7 days longer compared to controls) *(Efimenkova, D.A., Urban, V.G., 2011).*
- Fortification with 0.006% Dihydroquercetin lowered acid values in **mackerel-derived oils** stored at 20-25 °C for 128 days. Up till 63 days of storage, there were no significant differences in acidic number between the samples. By 128th day, the level of acidic value in the control sample significantly increased, while in the experimental samples it remained at a very high level, which was lower in Dihydroquercetin sample. During the storage period, the acid number in the control sample was twice as much as in Dihydroquercetin samples *(Baydalinova, L.Ya., 2008).*
- Fortification with 0.006% Dihydroquercetin lowered peroxide values in **mackerel-derived oils** stored at 20-25 °C for 128 days. The peroxide value in unrefined oil rapidly increased within the first 20 days, after which the rate of its increase subsided. In the samples with Dihydroquercetin, the peroxide values were relatively stable and their increase was observed only by the 128th day of storage *(Baydalinova, L.Ya., 2008)*.

Animal fats

- The addition of Dihydroquercetin to **melted chicken fat**, which was already at the initial stage of oxidation (the peroxide value 0.04% of iodine, the oxidative number 2.9 mg KOH), stored at a temperature 97.0±0.1 °C, led to a sharp increase in the induction period from 5.2 hours (mass concentration of Dihydroquercetin – 0.01%) to 25.6 hours (mass concentration of Dihydroquercetin – 0.05%). Thus, Dihydroquercetin effectively slowed down poultry meat fat oxidation and extended the induction period, with the resulting 10-17 time increase in stability of chicken fat toward oxidation at Dihydroquercetin concentration of 0.01% *(Krasyukov, Yu.N., 2006*).
- Fortification with 0.02% Dihydroquercetin increased the stability of **lard** toward oxidation at 4 °C in 3.7 times (from 23 days in the control samples to 85 days) *(Potipayeva, N.N., 2005)*
- The addition of Dihydroquercetin at 0.08% and 0.2% to **ground lard** completely inhibited oxidation processes during the 45 days of storage at 4-6 °C. The peroxidation values of the tested samples were 97.3% and 98.2% lower than in the control samples *(Tokayev, E.S., Novakov, P.A, et al., 2003).*
- When 0.015, 0.03, 0.06 and 0.1% of Dihydroquercetin was added to **lard** placed in open glass containers, the stability of lard to oxidation at room temperature increased with an increase in Dihydroquercetin concentration. The control sample was stable for 5 hours; at 0.015% DHQ lard was stable for 16 hours; at 0.03% DHQ – for 43 hours; at 0.06% DHQ, lard was stable for 79 hours *(Kurth, E.F., Chan, F.L., 1951)*.
- Dihydroquercetin added to **melted lard** in an absolute ethanol solution, prevented the oxidation of lard at 70 °C. The stability of the control sample was 8.8 hours; the stability of a sample with Dihydroquercetin was 47 hours *(Crawford, D.L., Sunnihuber, R.O., et al).*

METHODS OF DHQ INTRODUCTION

A number of patents, describing the methods and dosage of Dihydroquercetin introduction in various food systems, were published in Russia.

The methods and dosage of DHQ introduction in dairy and fatty food products were provided in this presentation below.

The data presented are based on the materials of published scientific studies, patents as well as on the practical application of Dihydroquercetin by the Russian Dairy Plants and Confectionery Factories.

Ground meat made from mechanically deboned chicken

Dihydroquercetin should be added at 0.05% per mass of raw material to ground meat from chicken (meat removed from the carcass, from the back and the shoulder). The duration of treatment 2-3 minutes for the proportional distribution *(Mayurnikova, L.A., 2005).*

Ground chicken from aerosol treatment

The eviscerated broiler-chickens are treated with a solution of active sodium hypochlorite by using aerosol method. Carcasses are cooled with the addition of 0.05% - 0.1% of peracetic acid. Dihydroquercetin should be added to ground chicken as an aqueous-alcohol solution (DHQ should be dissolved in 40% alcohol solution); mixed thoroughly, packaged, labeled, cooled or frozen *(Mandro, N.M., 2006).*

Natural ground meat

Add raw meat to the mixer with rotating blades, then Dihydroquercetin (as an aqueous-alcohol solution at 0.02% per mass of raw material). All compounds should be mixed thoroughly for equal distribution of food additive *(Mayurnikova, L.A., 2005).*

Jerked sausages from ground chicken

Carcasses of broiler chickens or others subjected to deboning, separating white meat from the breast and red meat from the thigh without skin. Cut trimmed poultry and fat into pieces and cool. Cut received meat into small pieces. Preparing the ground meat. Add the salting ingredients, spices with simultaneous introduction of Dihydroquercetin in the amounts of 0.02% by fat mass. Add the pork fat and mix *(Gonotskiy V.A., Dubrovskaya V.I. et al, Patent, 2007).*

Smoked sausages

Raw meat grinding, salting, ground meat preparation, filling the sausage casing with ground meat, heat treatment and subsequent cooling. The sausage casing should be steeped in protective solution for 3-9 minutes before filling them with ground meat. The finished product should be also treated with a layer of protective solution before cooling. The protective solution consists of sodium salt of polyvinylpyrolidone, salt, food acid salt, dihydroquercetin and water *(Snezhko, A.G., Novikov, V.M. et al., Patent, 2008).*

Semi-finished meat products

- Dihydroquercetin could be added to ground meat intended for production of semi-finished food products, i.e cutlets and frozen semi-finished products made of dough such as pelmeni or dumplings. Put all compounds of the formulation into stirrer machine in accordance with the generally accepted sequence and then put Dihydroquercetin in the amount of 0.02% by mass of the product. Mixing time - 2-3 minutes, up to even distribution of all components of ground meat *(Mayurnikova, L.A., 2005).*
- Dihydroquercetin should be added as an aqueous-alcohol solution (DHQ should be dissolved in 40% alcohol solution) in an amount of 0.025%, 0.05%, 0.075% by weight of the raw material. Mix Dihydroquercetin with the tenth part of the total mass of the raw material and add the received solution successively at the rotating blades of the stirrer machine up to even distribution of all components of ground meat *(Borozda, A.V., Denisovich Yu.Yu., 2009).*
- Dihydroquercetin should be added as 40% aqueous-alcohol solution with a concentration of 0.01% in the amount not more than 1% by mass of semi-finished products by using needleless injection device. The injected meat prepared for shish-kebab cut into pieces, mix with other ingredients of the formulation (Mandro, N.M., Moshchevikina, O.N., 2009).

Methods of fish processing

- Processing of chilled fish (eviscerated) with dihydroquercetin aqueous solution previously dissolved in 1% ethyl alcohol by using the method of irrigation.
- Preparation of crushed ice made of dihydroquercetin solution; pit fish into prepared ice.

CONCLUSION

Studies indicated Dihydroquercetin acts as a strong antioxidant in meat products, poultry, seafood products and fish oil. Dihydroquercetin can inhibit the formation of the primary oxidation products, free fatty acids in several meat systems. Some research papers suggested that Dihydroquercetin showed bactericidal activity against coliforms, S. aureus, clostridia and pathogenic microorganisms including Salmonella and E.coli in meat products. Dihydroquercetin displays antimicrobial properties in fish by inhibiting the growth of staphylococcus, diplococcus, and sartcin.

Product	Amount	Effect
Beef	0.02% by lipid mass	- Decreased the rate of accumulation of the primary products of oxidation; - Preserved its original odor, color and consistency
Chicken	0.02% by lipid mass	- Decreased the accumulation of the primary products of oxidation; - Significantly decreased the accumulation of free fatty acids and the formation of secondary oxidation products; - Preserved organoleptic properties of the product and stabilized its color
Fish (chilled salmon)	Spraying with 1% water solution of ethanol	- Preserved organoleptic properties (color, taste, odor) of the fish.
Fish (halibut, herring)		- Lowered the accumulation of the primary oxidation products.
Fish (mackerel)	0.006% by mass	- Lowered the levels of free fatty acids and the primary oxidation products.
Ground beef	0.05-0.075% by mass of the ground beef	- Decreased the accumulation of free fatty acids; - Inhibited the formation of the primary oxidation products; - Preserved its organoleptic properties
Ground chicken	0.025 by mass of the ground chicken	- Decreased the accumulation of the primary products of oxidation.
Ground deer	0.025-0.075% by mass of the ground deer	- Decreased the accumulation of the primary products of oxidation.
Ground lard	0.08 and 0.2%	- Completely inhibited oxidation processes.
Ground meat (pork:beef)	0.006% by lipid mass of ground meat or 1% alcohol solution with 0.02% DHQ by raw material mass	- Lowered the accumulation of free fatty acids and the production of the primary and secondary products of oxidation
Ground meat for boiled and smoked, smoked and dried sausages	0.01-0.05% by raw material mass	- Lowered the accumulation of free fatty acids and the production of the primary and secondary products of oxidation
Ground meat, made from mechanically deboned chicken	0.02 – 0.04% by lipid mass	- Decreased the rate of formation of free fatty acids

CONCLUSION

Product	Amount	Effect
Lard	0.02 – 0.05% by raw material mass	- Increased the active oxygen stability of lard from 5 hr to 69 hrs.; - Increased the oxidative stability of lard at 4 °C to 85 days; - Decreased the level of primary oxidation products in lard subjected to the influence of light.
Melted chicken fat, which already at the initial stage of oxidation	0.01% by fat mass	- Effectively slowed down poultry meat fat oxidation and extended the induction period, with resulting 10-17 times increase in stability of chicken fat toward oxidation
Mechanically deboned chicken (15% fat)	0.02-0.06% by lipid mass	- Significantly decreased the accumulation of free fatty acids, of peroxides, and the formation of secondary oxidation products; - Preserved organoleptic properties of the product and stabilized its color
Melted lard	0.02% by lipid mass	Prevented the oxidation of lard as was evaluated by the Active Oxygen Method.
Pork	0.02% by lipid mass	- Decreased the accumulation of the primary products of oxidation.
Poultry fresh-jerked sausage	0.02% by lipid mass	- Decreased accumulation of peroxides and free fatty acids
Raw pork fat	0.02% by raw material mass	- Inhibited the oxidation of the product, as was seen by a decreased in the accumulation of peroxides, free fatty acids, and of secondary oxidation products.
Semi-finished food products (minced and frozen)	0.02% by raw material mass	-
Semi-smoked sausages	0.006% by lipid mass	- Decreased accumulation of peroxides and free fatty acids
Shish-kabab made from pork	0.01%	- Inhibited the formation of primary and secondary oxidation products; - Inhibited the growth of microorganisms.