AMETIS, Closed Joint-Stock Company

DIHYDROQUECETIN
in Dairy Industry

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.
- GOST 53507-2009. Milk-containing sweetened condensed canned foods. General Specifications. Date of introduction: January 1, 2011;
- GOST R 54661-2011. Canned milk. Dry cream. Specifications. Date of introduction: January 1, 2011;

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This presentation was prepared by managers of 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

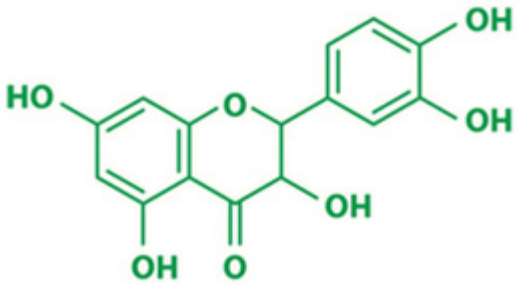
b) because of its capillary-strengthening properties, Dihydroquercetin can be used for functional products that are aimed at enhancing health.

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 dairy industry

1) Extends the shelf life

Dihydroquercetin increases the shelf life of dairy 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 milk and dairy 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 dairy 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 use of Dihydroquercetin in Dairy Industry

Yogurt

- Dihydroquercetin extends shelf life of yogurt (7.5% fats) to **60 days** *(Korenkova, A.A., 2006);*
- Dihydroquercetin preserved physic-chemical indices of yogurt (7.5% fats) during its storage *(Korenkova, A.A., 2006).*
- Dihydroquercetin inhibits the acid formation in yogurt *(Blinova T.E., Radaeva I.A., Zdorovcova A.N., 2008)*.
- Dihydroquercetin decreased the acidity in yoghurt fermented with Streptococcus thermophilus by average 12-15% compared to control *(Blinova, T.E, Radaeva, I.A., Zdorovtsova, A.N., 2008).*
- Dihydroquercetin preserves the stability of viable cells of the Bulgarian bacillus for longer time *(Blinova, T.E., Radaeva, I.A., Zdorovtsova, A.N., 2008).*

Sour cream

- Dihydroquercetin increased shelf life of sour cream (15% fats) to **40 days** *(Korenkova, A.A., 2006);*
- Fortified with Dihydroquercetin sour cream (15% fats) retained its original organoleptic properties (texture, taste, odor) after 40 days of storage *(Korenkova, A.A., 2006);*
- Dihydroquercetin killed on average 44% of lipolytic microorganisms in sterilized cream. Dihydroquercetin had a selective inhibitory activity of pathogenic microflora in sterilized cream. It killed on average 90% of Staphylococcus aureus, 30% of Listeria monocytogenes, and 12% of Escherichia coli *(Blinova, T.E., Radaeva, I.A., Zdorovceva, A.N., 2008).*
- Fortification of sour cream with Dihydroquercetin helps to decrease the titratable acidity. On the 7th day of storage the titratable acidity in the control sample has reached 76 ° T, which corresponded to the acidity of sour cream with Dihydroquercetin on day 21 (Pogosyan, D.G., Gavryushin, I.V., et al, 2011).
- Dihydroquercetin impacts therapeutic and prophylactic properties to a product and extends the shelf life to 20 days with no impact on the microbiological and organoleptic characteristics *(Pogosyan, D.G., Gavryushin, I.V. et al, 2011).*

Mayonese

- Fortification of mayonnaise with Dihydroquercetin (without application of other synthetic preservatives and antioxidants) contributes to maintaining the required level of quality of mayonnaise for 30 days *(Bazarnova, Y.G., Moskalev, Y.V, et al. Patent RU2345545 C2, 2006).*

The Influence of Dihydroquercetin on Microbiological Indices

L. monolcytogenes	Dihydroquercetin inhibits the growth of L.monoclytogenes 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

APPLICATION OF DIHYDROQUERCETIN

Milk and dry milk products

Dry milk

- Dihydroquercetin inhibited dry milk lipid peroxidation by **4 times** after 6 months of storage and by **2.6 times** after 8 months of storage at 20±2 °C as was determined by the intensity of chemiluminescence and the accumulation of MDA *(Klebanov, G.I., Teselkin, Yu.O., Babenkova, I.V., et al);*
- Dihydroquercetin extended shelf life of dry milk to **24 months** *(Radaeva, I.A., 1973);*
- Dihydroquercetin inhibited oxidative rancidity in dry milk in **3 times** *(Petrov, A.N., 2010);*
- Fortification of dry whole milk with dihydroquercetin and ascorbic acid promotes to decrease the thiobarbituric value in 1.6 times after 2 months of storage (Kobzeva, T.V., Gut, A.S., Radaeva, I.A., et al., 1998)
- Dihydroquercetin increases the resistance of dry whole milk, inhibits the oxidative processes, as well as the accumulation of toxic substances (Kobzeva, T.V., Gut, A.S., Radaeva, I.A., et al., 1998).
- Dihydroquercetin produced significant improvement of the flavor scores of **dry milk** powders stored at 80 °F for six months as was determined by a panel of trained judges using a standard score-card *(Tamsa, A., Mucha, T.J., Pollansch, M.J., 1963).*

Dry soymilk concentrate

- Dihydroquercetin extended shelf life of dry soymilk concentrate in 2 times *(Mandro, N.M., 2006)*;
- Fortification with Dihydroquercetin did not change taste, flavor or the appearance of **dry soymilk concentrate** *(Mandro, N.M., 2006)*;
- Dihydroquercetin decreased the accumulation of primary oxidation products in dry soymilk concentrate stored at +10 °C and 75% humidity for six months as was determined by the peroxide value *(Mandro, N.M., 2006)*;

Milk

- Dihydroquercetin inhibited the development of spontaneous oxidation in pasteurized milk produced during the dry-lot regime and stored for 96 hours at 1 °C as was determined organoleptically and by the TBA test *(Rajan, T.S., Richardson, G.A., et al., 1962).*
- Dihydroquercetin prevented oxidative flavor changes in milk stored for 3 days in dark storage at 1-2 °C as was determined organoleptically *(Richardson, G.A., Erickson, D.R., 1959).*
- Dihydroquercetin lowered acid-forming ability of inoculated in sterilized milk (4% fat) Lactobacilli after 108 days of storage at 4±2 °C *(Blinova, T.E., Radaeva, I.A., et al., 2008).*
- Dihydroquercetin preserved viability of inoculated in sterilized milk (4% fat) Lactobacilli after 108 days of storage at 4±2 °C *(Blinova, T.E., Radaeva, I.A., et al., 2008).*
- Dihydroquercetin preserved morphology of inoculated in sterilized milk (4% fat) Lactobacilli originally after 108 days of storage at 4±2 °C *(Blinova, T.E., Radaeva, I.A., et al., 2008).*

Butter

- Dihydroquercetin lowered the accumulation of oxidation products in butter after eight months of storage *(Reshetnik, E.I., 2008);*
- Dihydroquercetin prevented the accumulation of the primary oxidation products in butter stored at 2-6 °C, -3 °C, and – 18 °C for six months *(Mandro, N.M., 2006);*
- Fortification with Dihydroquercetin had no impact on the organoleptic indices, on the physic-chemical indices and on the microbiological indices of butter stored at 2-6 °C, -3 °C, and – 18 °C for six months *(Mandro, N.M., 2006);*
- Dihydroquercetin slows down generation of secondary oxidation products in butter. The antioxidative effect of Dihydroquercetin exceeds that of many other natural antioxidants (grape seed extract, grin tee extract, rosemary extract and others) *(Tokaev, E.S., Manukyan, G.G., 2009);*
- Dihydroquercetin decreased the accumulation of primary and secondary products of oxidation and lowered the level of carbonyl compounds in butter (82.2% fats) stored in a thermostat at 37±2 °C at in a refrigerator at 4±2 °C for one month. The antioxidative effect of Dihydroquercetin exceeded that of Rosemary *(Korenkova, A.A., 2006);*

Cream

- Dihydroquercetin killed on average 44% of lipolytic microorganisms in **sterilized cream**. Dihydroquercetin had a selective inhibitory activity of pathogenic microflora in sterilized cream. It killed on average 90% of Staphylococcus aureus, 30% of Listeria monocytogenes, and 12% of Escherichia coli *(Blinova, T.E., Radaeva, I.A., Zdorovceva, A.N., 2008).*

Kefir

- The fortification of finished milk products with Dihydroquercetin has a positive effect on microflora, stabilizing the viable cells at the end of the lead time and thereafter. Dihydroquercetin extends the shelf life of the product (Gomeleva, T.Y., Solodukhina, Ya.V., et al., 2011).

Condensed milk

- Dihydroquercetin inhibited the formation of free radicals at the early stages of storage of condensed milk as was determined by the accumulation of the primary products of oxidation *(Reshetnik, E.I., 2008);*
- Dihydroquercetin extended shelf life of condensed whole milk with sugar stored at 0 °C, 10 °C, 20 °C *(Mandro, N.M., 2006);*
- Dihydroquercetin preserved organoleptic qualities and had no effect on biochemical indices, microbiological indices of condensed whole milk with sugar stored at 0 °C, 10 °C, 20 °C *(Mandro, N.M., 2006).*

APPLICATION OF DIHYDROQUERCETIN

Processed cheese and cheese paste

- The influence of Dihydroquercetin on quality and storage period of food products was studied on processed cheese "Slaviyanskiy" with 55% fats and 53% of moisture content. Dihydroquercetin reduces the growth rate of mass fraction of oxidized substances in **2.5 times** compared to the control.
- Dihydroquercetin protected a lipid fraction of processed cheese stored at 2±2 °C for 150 days from oxidation. The rate of accumulation of oxidation products was much lower in the Dihydroquercetin-enriched sample (29%) than in the samples enriched with either Rosemary extract (39%) and BHT (45%). There was a 1.4 increase in the peroxide value in the Dihydroquercetin-enriched sample (vs. a 1.9 increase in the Rosemary sample and a 2.2 increase in the BHT sample) at the end of the storage period *(Rozdova, V.F., Kulakov, T.A., Ozhgikhina, N.N., 2009);*
- Dihydroquercetin extended the shelf life of **processed cheese** to up to 150 days *(Rozdova, V.F., Kulakov, T.A., Ozhgikhina, N.N., 2009);*
- Fortified with Dihydroquercetin **processed cheese** preserved its organoleptic properties after 150 days of storage at 2±2 °C *(Rozdova, V.F., Kulakov, T.A., Ozhgikhina, N.N., 2009).*
- Fortification of high-fat processed cheese with Dihydroquercetin (0.02% by fat mass) decreases the mass fraction of oxidized substances and peroxide value in 2.8 times, the acid number – in 2 times as compared with the control *(Dunaev, A.V., 2013).*
- Dihydroquercetin extends the shelf life of processed cheese in 2-2.5 times as compared with the shelf life of processed cheese of traditional composition *(Dunaev, A.V., 2013).*

The method of Dihydroquercetin introduction to processed cheese

Processed cheese

The method of Dihydroquercetin introduction to processed cheese is mentioned in the Amendment No 6 to Technical Requirements 9225-146-04610209-2003. The method of Dihydroquercetin introduction is demonstrated with an example of processed cheese "Yantar".

The cheeses used for the production of processed cheese "Yantar" should be: (1) set free from coatings, washed, cut into small pieces, ground in the mill, the received mixture placed to the hopper; (2) butter is cut and melted prior to introduction; (3) dry milk is dissolved in water prior introduction; (4) Before introduction Dihydroquercetin should be previously dissolved in water (at temperature 70-80 °C) on the basis of 1g per 50 mL of water; the received mixture should be mixed thoroughly; (5) the following melting salts are used in production of processed cheese "Yantar": the solution of the citrate and phosphate salts; (6) after selecting the melting salts, the process of cheese maturation is taking place. The received cheese goes melting. Then the processed cheese is hot moulded, then cooled and packed.

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.

METHODS OF DHQ INTRODUCTION

Methods of DHQ introduction to milk-containing products

Canned milk products

- the following technology of manufacturing of milk-concentrated product could be used: skimmed milk powder should be restored in water, cooled down, kept to mature, heated; then add molten anhydrous milk fat, vegetable fat; the received mixture is normalized; add Dihydroquercetin, stabilizing salt, salt; the received mixture is pasteurized; cooled down; add the sweetener , mix thoroughly, cool down, crystallize, cool down and packaged *(Patent RU 2275040 C2, 2006).* the following technology of manufacturing of concentrated sterilized milk could be used: skimmed milk powder should be restored in water, cooled down, kept to mature, heated, add vegetable fat, vegetable protein and Dihydroquercetin, normalize the received mixture, add stabilizing salts, the received product is homogenized; then the product is subjected to heat treatment; cooled down, packed and sterilized *(Patent RU 2002104921 A, 2003).*
- the following technology of manufacturing of condensed, dry or sterilized milk concentrate could be used: whole or skimmed milk is pasteurized, add dihydroquercetin as an aqueous solution or 10% alcohol solution (dihydroquercetin could be also added together with the solution of ascorbic acid), concentrate by vacuum evaporation and dry by spray drying (after concentration the received mixture could be homogenized, packaged, sterilized) *(Patent RU 2043030 C1, 1995).*

Soy milk concentrates and desserts

- The following technological process of manufacturing of soy-milk concentrates fortified with Dihydroquercetin could be as follows: acceptance and preparation of raw materials → normalization → pasteurization → thickening, preparation of Dihydroquercetin and its introduction into the thickened mixture → homogenization of thickened mixture → drying → packaging and labeling. Dihydroquercetin is recommended to add into normalized thickened soy-milk concentrate before homogenization as an aqueous-alcohol solution *(Mandro N.M, 2006).*
- The following technological process of manufacturing of fermented whipped dessert on soy-milk basis could be as follows: preparation of soy milk mixture → homogenization → pasteurization → cooling → fermentation, acidification → introduction of vegetable purees and Dihydroquercetin → mixing → cooling → whipping → packing *(Derzhapolskaya YI, 2009).*

Cream

The following method of dihydroquercetin introduction to high fat cream could be used: dihydroquercetin is mixed preliminarily with a part of the total amount of raw material and introduce consistently when mixing. The following technological scheme of cream manufacturing of is used: acceptance and preparation of raw materials → cooling → separation → pasteurization → separation → normalization → preparation and introduction of the antioxidant → thermomechanical treatment →packaging.

Sour cream

The following method of dihydroquercetin introduction to sour cream could be used: acceptance of raw materials → milk separation →processing of received cream or cooling → normalization of cream → homogenization → introduction of dihydroquercetin to the part of homogenized cream → mixing cream contained dihydroquercetin with the remaining part of cream → pasteurization → cooling the received cream up to the temperature of fermentation → fermentation and ripening of cream→ cooling down and sour cream maturation → packaging.

Butter

The following technology of manufacturing of butter fortified with Dihydroquercetin by using the method of high fat cream transformation could be applied: acceptance and preparation of raw materials → separation of milk, cream receiving → pasteurization → separation → normalization → preparation and introduction of Dihydroquercetin → thermomechanical treatment of high fat cream →oven control → packaging. Dihydroquercetin could be introduced as an aqueous or aqueous-alcoholic solution, after normalization, prior mixing the solution with Dihydroquercetin with the part of the total volume of raw martial *(Mandro N.M., 2006).*

Mayonese

Dihydroquercetin is introduced in the stage of preparation of mayonese emulsion *(Patent RU 2345545 C2, 2009).*

Fermented milk products

Dihydroquercetin is introduced prior milk ripening into sterile milk.

Cottage cheese

The following method of dihydroquercetin introduction to cottage cheese could be used: acceptance and preparation of raw materials, heating and separation of milk, normalization, pasteurization and cooling down, fermentation and introduction of dihydroquercetin, ripening, cutting, buttermilk separation, pressing, collong down the curd, packaging, labeling *(Yarkina, M.V., Mamaev, A.V., 2012).*

CONCLUSION

Product	Amount	Effect
Butter	0.02-0.025% by fat mass	- Inhibited the formation of the secondary products of oxidation; Decreased accumulation of primary and secondary products of oxidation and lowered the levels of carbonyl compounds; Lowered the accumulation of oxidation products. *DHQ could be added as aqueous or alcohol solution after normalization*
Sterilized concentrated milk-containing products	0.05 kg by 100 kg of raw material	- Increased the biological value of the product; Increased the upper temperature limit of the storage up to 15 °C. *DHQ should be introduced as a powder after the normalization of the mixture before pasteurization*
Sterilized concentrated milk		*DHQ should be added at the stage of vegetable fats introduction before normalization*
Milk concentrate in condensed, dry or sterilized form		*DHQ could be added after pasteurization as an aqueous solution or 10% alcohol solution before inspissation*
Condensed milk	NMT 1% by fat mass	- Inhibited the formation of free radicals at earlier stages of storage; - Preserved organoleptic indices; - Extended shelf life.
Condensed milk with sugar	0.05 kg per 100 kg of a product	- Increased the biological value of the product; - Increased the upper temperature limit of the storage up to 15 °C.
Cottage cheese	0.02% by fat mass	- Inhibited the production of aldehydes and extended the shelf life in 2 times.
Cream	0.02% by fat mass	*DHQ could be added as a powder in a part of the product, which is then mixed with the rest part. DHQ is introduced after normalization.*
Curd dessert with 5.5% fats	0.025% by fat mass	- Extended shelf life; Preserved organoleptic indices.
Dry milk	0.02% by fat mass	- Reduced flavor deterioration; Improved flavor scores; Inhibited lipid peroxidation in a concentration dependent manner; Inhibited oxidative rancidity in three times; Extended shelf life to 24 months.
Dry whole milk	0.02% by fat mass	- Extended shelf life to 24 months.
Dry soymilk concentrate	0.025% by fat mass	- Decreased accumulation of primary oxidation products and extended shelf life in 2 times (12 months), prevented the accumulation of oxidation products. *DHQ could be added to thickened mixture as an aqueous solution or alcohol solution.*
Mayonnaise	0.02% by fat mass	- Extended shelf life up to 30 days *DHQ is introduced as a powder or as an aqueous solution at the stage of preparation of emulsion*
Milk	0.02% by fat mass	- Prevented oxidation flavor changes.
Milk products made of whole milk 25% fats	0.02% by fat mass or 0.056 g/1kg of dry whole milk	- Extended shelf life to 1.5 – 2 times.
Pasteurized milk	0.02% by fat mass	- Inhibited the development of spontaneous oxidation.
Processed cheese with 45-70% fats	0.02% by fat mass	- Prevented the accumulation of the primary oxidation products; Extended the product's shelf life in 2 times (to 120 days). *DHQ could be added in a stage of cheese mixture preparation, previously dissolved in water*
Sour cream	0.025% by fat mass	- Extended shelf life to 40 days. *DHQ could be added as a powder in a part of the homogenous cream, which is then mixed with the rest part of cream.*
Sour-milk products	0.02% by fat mass	- Has the positive influence on growth and development of lactic acid bacteria. *DHQ is introduced as a powder into sterile milk before fermentation*
Yoghurt (7.5% fats)	0.025% by fat mass	- Extended the product's shelf life to 60 days