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# BIOCHEMICAL CHANGES IN LIPIDS OF LYOPHILIZED MEAT FOODS DURING STORAGE

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## Abstract

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The nutritional value of lipids depends not only on their energy equivalent but on the metabolism, structure, composition and changes occurring during technological processing of the product as well. The characteristic of unsaturated lipids determines their ability to enter into reactions with molecular oxygen. As a result, the accumulation of oxidized products causes damage to health. The character and quantity of the oxidized products are closely related to temperature and thermal effect, presence of water, salts, hemoglobin and myoglobin, amino acids, free fatty acids etc.

*Key words:* freeze – drying, meat foods, lipids, oxidative processes

## Introduction

First products obtained as a result of oxidation of natural lipids are hydroperoxides. The process is accompanied by the formation of conjugated double bond systems. The initial products have no colour and taste. Their concentration is determined by the indicator – peroxide number which characterizes the quantity of lipids.

It is scientifically proved that peroxide number of lipids in meat during technological processing depends on the raw materials and thermolability of the hydroperoxides formed. During thermal processing peroxide number slowly increases or remains unchanged but afterwards increases rapidly, exponentially goes through a maximum and then decreases (Obretenov, Ts. et al., 2002). Therefore in case of thermal dissociation of hydroperoxides, the quantitative characteristic of lipids, based on the peroxide number, is insufficient.

The mechanism and speed of hydroperoxides' decomposition depend on fatty acid composition of lipids and the specifics of their inhibitors and oxidants, temperature and other factors. Consequently, in various cases of hydroperoxides' decomposition, diverse secondary products can be obtained. Thus requires determination of their suitable concentration in parallel with the concentration of peroxides.

***Main objective:*** Our biochemical investigations were focused on the dynamics of the oxidative and hydrolysis processes in lipids in four types of lyophilized products containing poultry and veal meat (hams) during 1-year storage.

Samples are produced according to technology,

developed by researchers at the Institute of Cryobiology and Food Technology /ICFT/, which is based on minimum content of additives so as not to affect the organoleptic indicators and cause no preservation effect.

## Materials and Methods

– *Peroxide number*- iodine metrical method applied, which is based on the reaction between iodine –hydrogen acid and hydroperoxides, liberating equal quantity of iodine from the acid;

- *Acid number*- standard method applied through sample tittering into alcohol-ester solution with alcohol-potassium base in the presence of an indicator – phenolphthalein (in compliance with Bulgarian National Standards 1328-72);

- Thiobarbituric number-through distillation method of Tarladgis (Tarladgis et al., 1962);

- Ultraviolet spectroscopy - according to method of Popov and Yanishlieva (Yanishlieva et al.,1973);

## Results and Discussion

***Method of sublimation drying***, which is a combination of 2 processes- freezing and drying under vacuum, allows for eliminating disadvantages of other methods for preservation because the final products preserve their initial qualities-colour, aroma, nutritional properties, content of vitamins, stable volume, rapid rehydration (Tsvetkov et al., 1985).

***Lyophilization*** (freeze drying)-parameters for freeze drying, duration and speed of the process as well as the quality of the final product depend on physicochemical, biochemical and structural- mechanical properties (Miteva et al., 2008). Taking into account the above relation, we determine preliminary the parameters of the technological process, as follows:

a) *freezing*- in cameras with compulsory air convection at temperature from -35$^0$C to – 40$^0$C for 13-18 hours;

b) *sublimation drying*- temperatures of drying -40$^0$C, temperature of desublimator -65$^0$C, total pressure in sublimator- 0.20-0.35 mm/Hg and temperature to complete the process of drying –up to +30$^0$C.

The optimal regime programmed of drying should guarantee high quality of the products at maximum intensity of the processes. Main parameters of sublimation drying - temperature to complete congealment along with the maximum and minimum temperature of initial melting were determined according to the method of differential thermal analysis (DTA) and specific electric resistance ( Tsvetkov et al., 1979)..

Lyophilization was accomplished with the help of the sublimation installation – Hochvakuum TG -16.50.

Results, based on our investigations, proved that the new type of lyophilized foods have relatively low content of lipids.

Immediately after production, the initial oxidation of the lipids, expressed by the peroxide number, is the highest in the samples containing poultry meat of the third group (III p), lower – in the second group of samples containing veal meat (II v) and poultry meat (II p). The lowest rate of oxidation was observed in the first group of samples, containing veal meat (I v). Similar results were noticed for the second oxidation of the lipids, expressed by the values if thiobarbituric and acid number.

As a confirmation of these results serves the correlation A 232/270 which is obtained from the absorption of oxidized products - conjugated diene and triene fatty acids. The coefficient above and the values for peroxide, acid and thiobarbituric numbers obtained are comparable with the values reported in the literature related to the content of lipids in oxidized products.

After 1-month storage of the samples, we observed insignificant lowering of the peroxide number and it remains unchanged during next months of storage. This is probably due to the attenuation of the initial oxidative processes or to the lower speed of obtaining the initial products compared to the speed of their decomposition. Consequently, the peroxide number can not be regarded as a criterion for the rate of oxidation of the samples investigated. Reducing of the peroxide number leads to the increase of the products obtained from the secondary oxidation. The thiobarbituric num-

**Table 1**

**Oxidative and hydrolysis changes in lipids in lyophilized foods**

| Sample | Lipids in 30 g product | Lipids in 100g product | Peroxide number % J | Acid number KOH/g | Thiobar-bituric number E sm | Ultraviolet spectroscopy | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | A 232 nm 1% | A 270 nm 1% | A 232 270 |
| After production | | | | | | | | |
| I.v. | 3.11 | 9.33 | 0.63 | 2.4 | 0.443 | 88 | 30 | 2.93 |
| II.v. | 3.05 | 9.15 | 0.83 | 2.8 | 0.468 | 1037 | 362.5 | 2.86 |
| II.ch. | 3.5 | 10.5 | 0.85 | 2.95 | 0.46 | 611.1 | 213.3 | 2.86 |
| III.ch | 3.25 | 9.75 | 0.91 | 3.34 | 0.491 | 39.1 | 15.2 | 2.5 |
| After 1-month storage | | | | | | | | |
| I.v. | 3.39 | 10.17 | 0.48 | 2.7 | 0.711 | 850 | 315 | 2.7 |
| II.v. | 3 | 9 | 0.59 | 4.37 | 0.872 | 1282.2 | 500 | 2.56 |
| II.ch. | 3.51 | 10.53 | 0.78 | 3.76 | 0.783 | 1255.5 | 538.9 | 2.38 |
| III.ch | 3.28 | 9.84 | 0.85 | 4.63 | 0.88 | 577.6 | 255.5 | 2.26 |
| After 3-month storage | | | | | | | | |
| I.v. | 3.44 | 10.32 | 0.45 | 4.09 | 0.41 | 560.1 | 208.2 | 2.69 |
| II.v. | 3.15 | 9.45 | 0.48 | 4.86 | 0.415 | 600 | 208 | 2.98 |
| II.ch. | 3.53 | 10.59 | 0.56 | 3.42 | 0.36 | 680.3 | 243 | 2.91 |
| III.ch | 3.36 | 10.08 | 0.69 | 3.57 | 0.475 | 520.2 | 216.1 | 2.4 |
| After 6-month storage | | | | | | | | |
| I.v. | 3.49 | 10.47 | 0.6 | 3.77 | 0.49 | 583.47 | 216.1 | 2.7 |
| II.v. | 3.28 | 9.84 | 0.52 | 3.97 | 0.41 | 619.77 | 219 | 2.83 |
| II.ch. | 3.6 | 10.8 | 0.53 | 3.29 | 0.41 | 649.09 | 242.2 | 2.68 |
| III.ch | 3.39 | 10.17 | 0.67 | 2.99 | 0.408 | 531.64 | 220.6 | 2.41 |
| After 9-month storage | | | | | | | | |
| I.v. | 3.54 | 10.62 | 0.69 | 3.67 | 1.513 | 759.72 | 283.48 | 2.68 |
| II.v. | 3.33 | 10 | 0.66 | 3.7 | 1.88 | 630 | 280.04 | 2.25 |
| II.ch. | 3.59 | 10.78 | 0.57 | 3.55 | 1.12 | 802 | 340.01 | 2.36 |
| III.ch | 3.45 | 10.35 | 0.7 | 3.06 | 1.109 | 581.12 | 256.03 | 2.27 |
| After 12-month storage | | | | | | | | |
| I.v. | 3.55 | 10.65 | 0.66 | 2.9 | 1.74 | 816.66 | 308.89 | 2.64 |
| II.v. | 3.37 | 10.11 | 0.68 | 3.05 | 2.08 | 900 | 413.33 | 2.17 |
| II.ch. | 3.68 | 11.04 | 0.58 | 3.31 | 1.59 | 877.78 | 355.56 | 2.46 |
| III.ch | 3.45 | 10.35 | 0.66 | 2.92 | 1.84 | 772.22 | 264.44 | 2.32 |

v- veal meat

ch - chicken meat

ber is the highest in the samples containing poultry meat of the third group (III p), lower values are obtained in the second group of samples containing poultry meat (II p) and veal meat (II v). The secondary oxidation is mostly insignificantly in the samples containing veal meat of the first group (I v). Having into account this correlation A 232/270 resulting from the absorption values of dienes and trienes (it is in a reciprocal correlation with the other indicators), we can conclude that lipid oxidation after 1-month storage is the strongest in the samples containing veal meat and poultry meat of the second group and lower values (effect? in the samples containing poultry meat of the third group and samples containing veal meat of the first group.

It might be suggested the values of the indicators for lipids secondary oxidation (thiobarbituric number and A 270 nm, and to some extent it is valid for coefficient A 232/270) after 1-month storage increase in all samples analyzed.

In the 3-rd and 6-th month storage the secondary oxidized products remain almost unchanged. After 9-month storage it was observed slight increase in their values whereas in the 12 -month storage the values were clearly increased. The indicators of lipids secondary oxidation are also changed because of the albumin-lipid complexes formed in the substrate investigated.

In the samples of all groups, investigated for initial/ and secondary oxidation of lipids, immediately after production, it was observed much lower content of peroxides and conjugated dienes (A 232 nm). Lower values were detected of the indicators for secondary oxidation – thiobarbituric number and A 270, along with the coefficient A 232/270.

## Conclusions

Changes in the lipids of the new type lyophilized meat products depend on the initial chemical composition.

Components of the meat products investigated affect the lipid oxidation as inhibitors or protectors during production and storage.

Preservation of meat products through freeze-drying method guarantees their extended shelf life and safety.

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