ISSN 2347 - 3983
Volume 8. No. 7, July 2020
International Journal of Emerging Trends in Engineering Research
Available Online at http://www.warse.org/IJETER/static/pdf/file/ijeter91872020.pdf
https://doi.org/10.30534/ijeter/2020/91872020

# Formulation of Low Saturated Margarine for Preventive Nutrition

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**ABSTRACT**

Creating dietary margarine using biologically valuable substances is the purpose of the work. According to the results of the experiments, it was found that the use of soybean oil, edible vegetable phospholipids and a Jerusalem artichoke extract in the margarine, allowed reducing the amount of fat and enriching the margarine with omega-3 and omega-6 fatty acids, dietary fiber, inulin, and other water-soluble substances.Based on these studies, prepared margarine increased inulin and essential fatty acids, which provide not only a preventive property of the finished product but also high flavor indicators, as well as original and attractive appearance.

**Keywords:** soybean oil, Jerusalem artichoke extract, margarine, inulin,essential fatty acids

## 1. INTRODUCTION

It has been proven by scientists that excessive consumption of animal and solid fats and a lack of high-quality essential oils of concentrated essential fatty acids in the diet can lead to increasing atherosclerosis, cardiovascular disease, diabetes, cirrhosis and other diseases.Therefore, usingthe margarine products with a low fat content is popular in developed countries [1].
Nutrition issues, the creation of optimally balanced food rations for different population groups are given priority in the most developed countries of the world [2].The main vegetable oils or non-dairy fat compositions into the formulation; the combination of hydrogenated fat and vegetable oils provides the potential for mutual enrichment of the ingredients that make up these products according to one or more essential factors and allows you to create products with a balanced composition, including specially designed target varieties [3].
The biological effectiveness of lipids is determined, on the one hand, by the structural characteristics of fatty acids, and on the other hand, by their ratio and content in fats of components of various nature and functional orientation.The main role in the composition of fat belongs to essential polyunsaturated fatty acids - linoleic $C_{18:\ 2}$, linolenic $C_{18:3}$ and arachidonic $C_{20:4}$.These fatty acids, like some protein amino acids, are indispensable, not synthesized in the body, and their needs can be satisfied only at the expense of food. These highly unsaturated objective of the oil and fat industry in food industry is the development of low-calorie physiological fatty products enriched with biologically valuable substances.In solving this problem, the main role is given to the creation of products which are water-fat emulsions of direct (oil in water) and reverse (water in oil) types, which is due to the wide possibilities for varying the composition and obtaining final products with desired properties
In solving this problem the main role is given to creating products which are water-fat emulsions direct (oil-in-water) and inverse (water-in-oil) type, that is caused by wide possibilities of varying the composition and obtaining final products with desired properties.

## 2. METODOLOGY

As the object of the research were water-fat emulsions and products based on them (margarine), which obtained in the laboratories under production conditions. As a raw material were used the standard for fat products obtained in the Tashkent Oil and Fat Factory. As emulsifiers were used edible vegetable phospholipid concentrates (Alfa-Soy, Samarkand, Uzbekistan).

### 2.1. Preparing fat base of margarine

In the conception of developing the assortments of margarines, a number of areas are highlighted, the priority of which are: directional regulation of the fatty acid composition of the product, by introducing polyunsaturated fatty acids, according to their biological properties belong to the vital nutrients, and therefore they are positioned as a complex of vitamin [4].
Among foods, the richest polyunsaturated fatty acids (PUFA), vegetable oils, the content of linoleic acid 50-60%, much less than in its spreads - up to 20%, very little in animal fats - up to 3-5% [5]. The recommended ratio of ω6/ω3 amounts in the diet of healthy human 10: 1, for clinical nutrition from 3: 1 to 5: 1 [6].Among a large number of works confirming the positive effect of PUFAs on the human body, and primarily their anti-sclerotic focus, there are studies showing a negative effect on diets, the entire fat complex of which is represented exclusively by vegetable oil. Excessive intake of linoleic acid into the body is undesirable, due to its high oxidation ability and the ability to form free radicals, inhibiting the normal course of metabolic processes in the body [8].

On the basis of above data, we have developed margarine formulations from local fatty raw materials: soybean, sunflower, cottonseed oils, hydrogenated fat, and also investigated the physicochemical properties of the margarine.

The main ingredient in the production of margarine is hydrogenated fat. The hydrogenated fat is obtained by hydrogenation of vegetable oils and animal fats.

To improve the quality of margarines and increase the thermal stability of the product, it is recommended to use the builders – low iodine hydrogenated fats [9].

Leading manufacturers are developing recipes for margarine products based on market requirements, dietary trends in human nutrition and the desire to reduce the cost of production.

The dietary effect is to reduce the total amount of consumed fats, decrease the cholesterol level (less than15 mg / kg), increase the consumption of unsaturated fats (not less than 50%) and decrease the level of saturated fats (less than 25%).

Depending on the purpose, margarine products must have a certain melting point (fusibility) and ductility. Fusibility is characterized by the temperature of complete melting, which depends on the content and quantitative ratio of solid and liquid fractions: the higher the content of the solid high-melting fraction, the lower the fusibility. Plasticity depends on the ratio of solid and liquid glycerides. Fats have good ductility and spreadability, if the amount of solid glycerides is 15-30%. In dense and non-ductile fat, the content of solid glycerides is more than 30%, and in too soft fats - 10-12%.

Based on the components listed above, we conducted research work in creating a fatty base of diet margarine with optimized properties. The investigation was used edible hydrogenated fat, cotton palmitin, soybean, sunflower and cottonseed oil (Tashkent Oil and Fat Plant, Tashkent, Uzbekistan).

Table 1 shows that, the hydrogenated fat were partially replaced with vegetable oils and cotton palmitin. Increasing the amount of liquid oils leads to raising the essential fatty acids in the composition of margarine, decreasing the melting point and hardening of margarine. But by maintaining the builders in the fat base of margarine, its melting point and hardness increase.

In the production of dietary margarines and spreads, edible plant phospholipids are used as an emulsifier and dietary supplement [7]. In this work [8] researchers carried out experiments on the hydration of soybean oil and obtained phosphatide concentrate. In the preparation of margarine, we used this phosphatide concentrate.

**Table 1:**The fat base of margarines

| **Fat Margarine Ingredients** | **Samples in %** | | |
|---|---|---|---|
| | **present** | **present** | **suggested** |
| Hydrogenated fat, $T_{mp}$ 31-34 ° C, hardness 160-320 g / cm | 50 | 45 | 26 |
| Hydrogenated fat, $T_{mp}$ 35-36$^{o}$C, hardness350-410g/cm | 25 | 30 | 22 |
| Cotton palmitin$T_{mp}$20-25$^{o}$C | - | - | 20 |
| sunflower oil | - | 25 | 10 |
| cottonseed oil | 25 | - | 10 |
| Soybeanoil | - | - | 10 |
| The builder(deep hydrogenated oil) | - | - | 2 |
| Total | 100 | 100 | 100 |

### 2.2. Preparing Jerusalem artichoke extract

Inulin is used as a technological ingredient in the food industry. Inulin is added to baby foods, pastries, dairy products, chocolate, diet foods, etc. [10].

Interestingly, inulin is used in the manufacture of low-fat foods in order to reduce their calorie content.This turns out because in this way the presence of fat in the product is simulated - when combined inulin, with water, is able to form a creamy substance texture similar to fat [11].

Inulin, falling into the intestine saprophytic bacteria splits into separate molecules of fructose and short fructose chains penetrate into the bloodstream.

The remaining undigested; most of the inulin is excreted by binding a large number of substances unnecessary to the body. These are heavy metals, radionuclides, cholesterol crystals, fatty acids, various toxic chemical compounds that enter the body with food or formed during the life of pathogenic microbes living in the intestines [12].

Fructose - one of cleavage product of inulin is an energy source for body cells. Moreover, fructose metabolism does not require the participation of insulin, which is a key point for patients with type 2 diabetes. Inulin does not affect the level of post-food glucose in the blood. Therefore, inulin has a zero glycemic index [13].

Inulin molecules can absorb a significant amount of dietary glucose and inhibit its absorption in the blood, which helps to reduce blood sugar after eating. At the same time, such toxic metabolic products, as acetone and other ketone bodies, which have a detrimental effect on the patient's body, are bound and excreted from the body.Short fructose fragments of inulin and organic acids (malic, fumaric, malonic, citric, succinic and others) perform auxiliary antioxidant and antitoxic functions, strengthening the body and helping its workin the blood. Therefore, inulin can be used in the treatment of patients with the presence of a newly diagnosed or mild form of type II diabetes mellitus, as a means of primary prevention of diabetes mellitus in people with a history of glucose tolerance disorder, in patients with metabolic syndrome (carbohydrate metabolism disorder, hypertension, hyperproteinemia) as a means aimed at normalizing carbohydrate and lipid metabolism. Inulin successfully fights overweight. Firstly, it is not absorbed in the stomach; therefore, all the calories (which are already not many) actually go to useful intestinal microorganisms.Secondly, inulin creates a feeling of satiety, and natural sweetness allows you to do without sugar. The beneficial properties of inulin are determined by the amino acids included in it: leucine and isoleucine help to produce insulin, restore sugar levels; methionine, arginine, and threonine - also prevent the development of fatty degeneration of the liver; phenylalanine and tryptophan - reduce appetite. Inulin selectively changes the number of intestinal microorganisms (a significant increase in the number of bifidobacteria and lactobacilli, reducing the number of pathogenic organisms), thereby reducing the body mass index (z-score), percent body fat in individuals with overweight [14].

Inulin for 95% consists of natural fructose, which (unlike glucose), firstly, penetrates into cells without any participation of insulin, and secondly, replaces glucose in metabolic processes that occur in the human body. Therefore, Jerusalem artichoke and preparations based on it are indicated for people suffering from diabetes. Inulin, which belongs to the group of prebiotics and contained in large quantities in Jerusalem artichoke, acts on the body as follows [15]:

– improves glucose utilization, thereby contributing to the synthesis of glycogen, protein, “good” cholesterol, bile acids.

– restores the normal functioning of the digestive tract by neutralizing the harmful effects of toxic substances and toxins in the intestine, as well as in the blood

–restores the functional activity of insulin, that brings closer to normal the state of absolutely all types of metabolism, including fat.

– improves the absorption of calcium by bone tissue. So, taking Jerusalem artichoke not only stimulates bone growth, but also prevents (or stops) the symptoms of bone diseases.

– Favorably affects the immune system. Jerusalem artichoke in particular, and inulin-containing additives based on this plant as a whole, are rightly considered natural immune modulators, analogues of which do not exist. Inulin helps to increase the population of beneficial intestinal microflora (referring to bifidobacteria and lactobacilli), which prevents the multiplication of various pathogenic microorganisms directly in the intestine. And this, in turn, helps to reduce blood cholesterol.

–reduces the risk of developing cardiovascular diseases, as it prevents the formation of blood clots, lowers blood pressure and reduces the concentration of “bad” cholesterol in the blood.

– improves bile formation and bile secretion, thereby reducing the risk of liver and gall bladder diseases.

It has been proven that inulin-containing plants, including Jerusalem artichoke, have a hepatoprotective effect, therefore, they are recommended for patients with viral hepatitis B and C occurring in the chronic stage. For isolation of inulin from Jerusalem artichoke tubers were used in the inulin property - dissolve in hot water.

For research we used Jerusalem artichoke tubers mainly of the “Fayz Baraka” variety, which were washed, cleaned, blanched and crushed to particles about 1 - 2 mm in size. The resulting pulp was subjected to extraction with water at a temperature of 75 °C with a water module of 1: 4 for 60 minutes [16-20].

**Table 2:**The composition of the water extract in Jerusalem artichoke

| № | Components | Content, % | | |
|---|---|---|---|---|
| | | Initial | Afterevaporation | |
| | | 1-sample | 2-sample | 3-sample |
| 1 | Proteins | 0,8 | 1,34 | 1,6 |
| 2 | Carbohydrates, including: | 16,3 | 27,34 | 32,6 |
| | mono- anddisaccharides | 6,7 | 11,24 | 13,4 |
| | inulin | 9,6 | 16,11 | 19,2 |
| 3 | Alimentaryfiber | 0,8 | 1,34 | 1,6 |
| 4 | Organicacids | 0,1 | 0,17 | 0,2 |
| 5 | Ash | 1,2 | 2,01 | 2,4 |
| 6 | water | 80,8 | 67,78 | 61,6 |

The extraction of the test samples was carried out on a specially made laboratory setup with constant stirring. The resulting solution was filtered through a cotton pad to get rid of large particles. Then the obtained Jerusalem artichoke extract was bleached using active carbon, evaporated and concentrated in a vacuum. After evaporation, Jerusalem artichoke extract of various concentrations was obtained. The composition of the water extract of Jerusalem artichoke is shown in Table 2.

First, the water content in the solution was reduced from 80.8 to 67.78% (Sample 2), and then to 61.6% (Sample 3).In turn, the inulin content increased from 9.6% to 16.11% and 19.2%.

In the next experiments, this solution of Jerusalem artichoke extract was used instead of pure water.

## 3. RESULTS

Based on the components obtained in the laboratory, we conducted research to create diet margarine with optimized properties. Due to the addition of highly unsaturated soybean oil, citric acid is added to the formulation. Succinic acid is also added to increase dispersion and stability to the oxidation of margarine. The compiled recipeis shown in Table 3.

**Table 3:**Margarine Recipe

| Margarine ingridients, % | Samples | | | |
|---|---|---|---|---|
| | **M1** | **MI2** | **MI3** | **MI4** |
| Fat base | 70 | 68,15 | 66,69 | 65,9 |
| Dye | 0,1 | 0,1 | 0,1 | 0,1 |
| Emulsifier | 0,2 | 0,2 | 0,2 | 0,2 |
| Milk | 10 | 10 | 10 | 10 |
| Salt | 0,4 | 0,4 | 0,4 | 0,4 |
| Nutritional phosphatide concentrate | 2,0 | 2,0 | 2,0 | 2,0 |
| Sugar | 0,4 | - | - | - |
| Antioxidant | 0,05 | 0,05 | 0,05 | 0,05 |
| Water | 16,85 | - | - | - |
| Jerusalem artichoke water extract | | | | |
| sample - 1 | - | 19,1 | - | - |
| sample - 2 | - | - | 20,56 | - |
| sample – 3 | - | - | - | 21,35 |
| Total | 100 | 100 | 100 | 100 |

In the Table 3 it is shown that with an increase in the mass fraction of water or an aqueous extract of Jerusalem artichoke from 16.85 to 21.35, the mass fraction of the fat base decreases from 70 to 65.9%. Sugar was added by using water and was not added to the water extract of Jerusalem artichoke. This is due to the presence of mono- and disaccharides in the water extract of Jerusalem artichoke. Figure 1 shows the changes in the mass fraction of the fat base, as well as water and inulin in the composition of margarine. The Figure 1 shows that by reducing the mass fraction of fat to 65.9%, the mass fraction of inulin increases to 4.1%. The water in the margarine is also reduced to 13.15%.

On the basis of recipe margarine is prepared in laboratory conditions. For this, the mixture of prescription components is mixed until a homogeneous emulsion is obtained and overcooled. Based on these studies prepared margarine enriched inulin and essential fatty acids, which provide not only a preventive properties of the finished product, but also high flavor indicators, as well as original and attractive appearance.

Table 4 shows the organoleptic and physicochemical indicators of margarine.

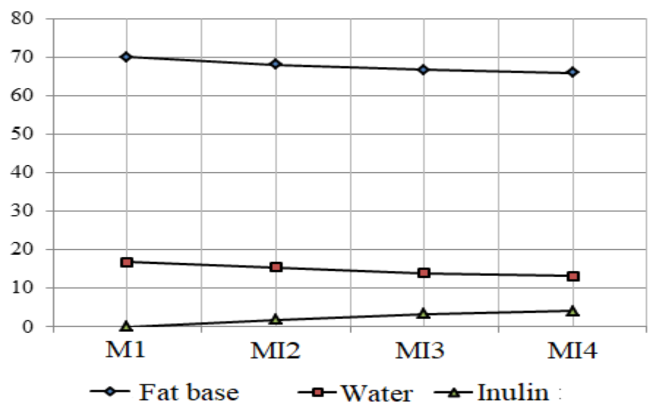


**Figure 1:** Changes in the mass fraction of the fat base, water and inulin in the margarine

**Table 4:**The organoleptic and physicochemical indicators of margarine

| **Nameofindicator** | **Standardformargarinebrands** | | | |
|---|---|---|---|---|
| | **M1** | **MI2** | **MI3** | **MI4** |
| Consistency and appearance at temperature (20±2) °C | Consistency plastic, dense, homogeneous. The cut surface is shiny, dry-looking. | | | |
| Tasteandsmell | The taste and smell are clean, milky. | | Taste and smell clean, milky, slightly sweet. | |
| Colour | Light yellow, homogeneous throughout the mass | | | |
| Mass fraction of fat,%, not less than | 72 | 70 | 69 | 68 |
| Mass fraction of moisture,%, not more | 26 | 24,6 | 23 | 22,3 |
| Melting point of fat extracted from margarine, °C | 27-32 | 27-32 | 27-32 | 27-32 |
| Margarine acidity, °C, not more | 2,8 | 2,8 | 2,9 | 2,9 |

## 4. CONCLUSIONS

The obtained margarine has a high plasticity, higher degree of dispersion, process ability, durability and oxidation stability. Furthermore, the addition of nutritional vegetable phospholipids and a Jerusalem artichoke extract in water increases the nutritional value of the proposed margarine.

As a result of the experiments, it was found that the use of soybean oil, nutritional vegetable phospholipids and a Jerusalem artichoke extract in the margarine made it possible to reduce fat and enrich margarine with omega-3 and omega-6 fatty acids, dietary fiber, inulin, and other water-soluble substances.

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