INFLUENCE OF HEAT TREATMENT ON MICROBIAL CONTAMINATION OF EMULSION FAT COMPOSITE MIXTURES

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ABSTRACT

The article describes a method for obtaining emulsion fatty composite mixtures by blending with flour from sesame and sunflower oil cake without heat treatment and subjected to pasteurization. Microbiological screening of products with and without additives was carried out during storage. It was found that mixtures with additives without heat treatment had a relatively high contamination and after 15 days of storage at a temperature of 5.0 ± 1 ° C did not meet the requirements of SanPiN, in contrast to prototypes with additives subjected to preliminary heat treatment, which contributed to the extension of the shelf life of fatty mixtures up to 45 days. The optimal dosage of flour from the raw materials under study has been determined up to 10.0% inclusive to the mass of raw materials of emulsion mixtures, which, according to organoleptic indicators, can be identified as spreads.

KEYWORDS: *sesame seed cake, hull-free sunflower cake, emulsion fat-and-flour composite mixture, heat treatment, microbiological purity, food safety, consumer value.*

INTRODUCTION

Recently, in the most developed European countries, the food market has been dominated by a trend called “wellness”. This multifaceted concept is translated from English as "good health, which is the result of a healthy lifestyle and an active life position." People are increasingly making conscious choices in favor of healthy foods, including those that help to solve certain functional tasks associated with maintaining health. The wellness mission has enormous potential for the development of manufacturing companies operating in the food market.

The share of "healthy" foods in all known food products is relatively low. It is predicted that in the next one to two decades the potential of the European market for these products will exceed 30% of all food products sold. The most dynamically developing food groups are in the sector of "healthy" oil and fat foods, therefore, expanding the range of fat and oil products that are beneficial to health has good prospects [1-7].

The biotechnological properties of oils and fats are due to fatty acid and triglyceride compositions, as well as the presence of biologically active compounds (tocopherols, sterols, phospholipids, carotenoids, etc.) in them. Wheat germ oil, which is included in a number of blends, is considered the “record holder” in terms of the amount of tocopherols.

The basic criterion for the nutritional value of these products is their fatty acid composition, therefore, in order to transform a traditional fatty product into a product with increased biological value, it is necessary to adjust its composition.

The study of the fatty acid composition of natural oils showed that in nature there is no “ideal” oil with a composition that ensures the intake of essential fatty acids into the human body in the right amount and optimal ratio.

The most effective way to create fatty products with a balanced composition and ratio of PUFAs of the ω-3 and ω-6 families is the blending of vegetable oils, as well as the use of biologically active additives in the form of oil preparations and powders with a high (up to 30%) acid content ω-3 [8-13].

To solve this problem, it is advisable to use sesame oil or sunflower seeds. However, due to the high cost, the content of these oils in blends usually does not exceed 1.0 ... 5.0%. In addition, the extraction of oil from germs is a laborious process with a very low yield. Therefore, the development of new methods for the production of fat composite mixtures with the inclusion of dry ingredients, in particular sesame meal or hullless sunflower meal, is very promising, especially for expanding the segment of fatty products for flour products.

Sesame (sesame) is cultivated in the world as a source of oil and protein, the content of which in sesame seeds reaches 55.0 and 20.0%, respectively. Sesame flour (cake) is a natural storehouse of vitamins E, A, T, B (B1, B2, B3, B5, B6, B9), macro- and microelements (calcium, zinc, phosphorus, magnesium, selenium). Sesame cake is used as an anthelmintic; used for anemia, internal bleeding and hyperthyroidism, accelerates blood clotting; - prevents the formation of blood clots, opens blockages in the veins. Sesame oil in the oil cake has a hypocholesterolemia effect, which is usually associated with antioxidant properties and the peculiarity of the fatty acid composition of this oil. Antioxidant properties are due to the presence of fat-soluble lignans (mainly sesamin and sesamolin) and vitamin E. These lignans have a sparing effect on vitamin E, preventing its oxidation. The metabolites of sesamin (catechols) formed in the liver have a pronounced antiradical activity. Sesamin increases the bioavailability of g-tocopherol by inhibiting its metabolism [14-18].

Sunflower cake is a product that is obtained by pressing oil from the remains of sunflower seeds. Along with this, sunflower cake contributes to: improving the immunity of livestock; excellent work of the reproductive organs of mammals; egg production of poultry; rapid growth of muscle mass; improvement of metabolic processes in the body of animals. In addition to residual oil, the product contains 35-40% fiber and protein. It also contains sucrose, vitamins A, B and E, phosphorus, biotin, choline, panthenolic acid, calcium, potassium and other trace elements. Of the amino acids, it contains the most methionine, but there are others. Sunflower cake has a residual amount of sunflower oil up to 15.0%, which has high quality indicators, incomparable with fodder oil: low degree of oxidation, high content of vitamin E and phospholipids, contains B vitamins, beta-carotene (provitamin A). Due to the content of oil in the cake, no additional costs are required for the purchase of oil for the preparation of the product [19-21].

It should be noted that oilseed cake, as a protein and carbohydrate-containing raw material, is a favorable nutrient medium for the development of microorganisms. The contamination of oilseed cake with microorganisms begins to form at the stage of harvesting and processing of oilseed raw materials. Operations that are mandatory in the process of preparing raw materials for extracting oil from it (hydrothermal treatment followed by drying) are accompanied by a decrease in microbiological contamination, but do not give the effect of sterilizing raw materials and the resulting cakes. The grinding of the latter into flour is accompanied by re-contamination. In this case, the total seeding can increase to critical values. In turn, the development of microflora is one of the main causes of hydrolytic decomposition and lipid oxidation, provoking an increase in the indicators of oxidative spoilage of raw materials [22-24].

It is known that most microorganisms belong to mesophylls, for the growth and development of which the temperature minimum is 5...10°C, while the optimum is between 25 and 35°C, and the maximum is within 45...50°C. Even for extreme thermophiles found among prokaryotes and developing at temperatures above 70°C, the maximum growth temperature lies in the range from 80 to 90°C [24-28].

In the aspect of the above, an assumption was made about the expediency of preliminary pasteurization of the studied raw material at a temperature of 100 ± 5 ° C for 10 ... 15 minutes, which will increase the degree of its microbiological purity in order to ensure the food safety of both the product itself and products prepared using it. , as well as reduce the enzymatic action of lipase, protease and lipoxygenase in it.

In order to confirm this assumption, studies were carried out using a composite mixture of the prescription components of margarine "For Baking" (RTs 64-00392738-02-2004) and flour from the studied types of cake, subjected to heat treatment (MZhPT) and without it (MF). The product was subjected to heat treatment immediately before blending, then ground to the size of dietary flour (withdrawal from sieve No. 27 no more than 2.0%, passage of sieve No. 38 - at least 60.0%).

Since the upper limit of the MZP dosage, established by our earlier studies [9], was 10.0% (of the total prescription amount of raw materials), it was precisely such an emulsion composite mixture that was studied to determine the microbiological contamination. Comparison sample, i.e. control, served as margarine without additives.

The studied samples were stored at a temperature of 5.0±1.0°C for 60 days. After equal time intervals (15 days), samples were taken for microbiological screening and comparison of the obtained data with the relevant requirements of SanPiN 0366-19. Determination of the dynamics of the species and quantitative composition of microorganisms was carried out by the standard method. A series of 10-fold dilutions in saline was prepared from the selected samples. The degree of dilution of margarine 1:103. The inoculation was performed according to the generally accepted method on meat peptone agar (MPA), bacteria of the Escherichia coli group were detected by inoculation on Endo's medium (Levin's medium or bismuth sulfite agar), yeasts and fungi - on Sabouraud's medium [29].

The results of the study are shown in tables 1 - 3.

Microbiological screening showed that microorganisms, to one degree or another, were contaminated with all the studied samples (Table 1).

TABLE 1 - CHANGES IN THE COMPOSITION OF THE MICROBIAL ECOSYSTEM IN THE CONTROL (MARGARINE) AND EXPERIMENTAL SAMPLES OF EMULSION FAT AND FLOUR MIXTURES DURING STORAGE

№	Term incubation, day	КМАФАнМ, ($\times 10^3$) КОЕ/g	Yeast ($\times 10^2$), КОЕ/g	moldy mushrooms, КОЕ/г	bacteria E.coli, КОЕ/г	Compliance with the requirements San PIN 0138- 03
Control						
1.	**1**	**11±2,3**	**-**	**-**	**-**	corresponds
2.	**15**	**76±2,3**	**-**	**-**	**-**	corresponds
3.	**30**	**198±2,5**	**-**	**-**	**-**	corresponds
4.	**45**	**323±2,5**	**0,4±0,2**	**-**	**-**	corresponds
5.	**60**	**438±2,7**	**1,6±0,4**	**60±5,0**	**-**	**doesnotmatch**
Experiencewith MF						
1.	**1**	**379±10,6**	**4,7±0,7**	**-**	**-**	corresponds
2.	**15**	**498±10,6**	**12,4±0,7**	**127±7,0**	**0,01±0,05**	**doesnotmatch**
Experiencewith MZHT						
1.	**1**	**24±4,7**	**-**	**-**	**-**	corresponds
2.	**15**	**116±4,7**	**-**	**-**	**-**	corresponds
3.	**30**	**226±4,7**	**-**	**-**	**-**	corresponds
4.	**45**	**359±4,7**	**4,2±0,2**	**32±5,0**	**-**	corresponds
5.	**60**	**507±4,7**	**11,5±0,4**	**105±5,0**	**-**	**Does not match**

In the test samples prepared with and without heat-treated flour, the amount of bacterial, yeast and mold microflora during storage exceeded the similar values of the control variant. The results of the studies showed that the microbiological contamination of the feedstock was: QMAFAnM - 27×103 CFU/g, molds and yeasts - 18 CFU/g, spore-forming bacteria - 27 CFU/g.

It was found that the number of microorganisms during the storage period (60 days) increased in the control variant by an average of 20.8 times, experimental - by 28.0 times, yeast, respectively, by 4 and 6 times. After the specified storage period in the test samples, the number of microorganisms exceeded the similar control values by an average of 53.4% (total number of microorganisms) and 75.0% (moulds). In the crops, yeasts were found, small and medium colonies are uniform, mucous in the form of monocultures. At the same time, colonies typical of E. coli and other pathogenic microflora were not found in the test samples after incubation on Endo medium. Experimental samples with additives already after 15 days of storage did not meet the requirements of SanPiN in terms of microbiological indicators.

The increased microbiological contamination of the fat and flour composition of mixtures with flour from the studied raw materials, relative to the reference sample, is explained by the improvement in their chemical composition due to the biologically active substances of the latter. The change in the microbial ecosystem of the studied samples during storage correlated with informative indicators of the quality of the studied samples during storage, presented in Table 2.

TABLE 2 INFLUENCE OF HEAT TREATMENT OF THE EMBRYONIC PRODUCT ON THE SAFETY OF EMULSION FAT AND FLOUR MIXTURES

№	Qualityindicators	Storagetime, days				
		1	15	30	45	60
1.	*Acidity, ^{0}K (in Ketstoffer degrees)*					
	Control	2,8±**0,2**	2,9±**0,2**	3,2±**0,2**	3,2±**0,2**	3,3±**0,2**
	Experiencewith MF	3,3±**0,5**	4,8±**0,5**	7,1±**0,5**	9,2±**0,5**	11,6±**0,5**
	Experiencewith MZHT	3,1±**0,3**	3,3±**0,3**	3,5±**0,3**	3,7±**0,3**	3,9±**0,3**
2.	*Peroxide value, mmol of active oxygen / kg*					
	Control	1,5±**0,3**	2,4±**0,3**	2,9±**0,3**	3,2±**0,3**	3,4±**0,3**
	Experiencewith MF	4,4±**0,6**	8,7±**0,6**	13,5±**0,6**	21,2±**0,6**	27,4±**0,6**
	Experiencewith MZHT	1,7±**0,4**	2,9±**0,4**	3,4±**0,4**	3,7±**0,4**	4,6±**0,4**
3.	*Anisidinenumber, arb.*					
	Control	2,40±**0,1**	2,40±**0,12**	2,50±**0,12**	2,50±**0,12**	2,60±**0,12**
	Experiencewith MF	3,91±**0,6**	5,62±**0,64**	7,36±**0,64**	10,44±**0,64**	14,68±**0,64**
	Experiencewith MZHT	3,30±**0,3**	3,52±**0,31**	3,54±**0,31**	3,62±**0,31**	3,75±**0,31**

As the acid number in the studied products increased as a result of hydrolysis with lipase, the ability of fat to be oxidized by lipoxygenase increased, which led to a regular increase in the peroxide number of products, respectively, by 6.2 and 2.7 times in samples with the embryonic product without and after heat treatment at the control value by 2.3 times, since the processes of hydrolysis and fat oxidation are interdependent.

Samples with MZHT, naturally, were characterized by increased values of the anisidine number relative to the reference sample (there is no standard for an anisidine number for high-quality fat, but in world practice the value of this indicator should not exceed 3 conventional units) with a positive tasting assessment and only the end of the storage period under consideration, the organoleptic indicators of the products deteriorated markedly (Table 3). At the same time, samples with MF already after 15 days of storage received an unsatisfactory tasting assessment. A significant increase in the values of the anisidine number in these experimental samples is probably due to the influence of the oil cake's own enzymes, which are in the active state (non-inactivated) and during storage of fat and flour mixtures catalyzing the processes of secondary oxidation of fats.

TABLE 3 - INFLUENCE OF FLOUR OF THE GERMINAL PRODUCT ON THE ORGANOLEPTIC CHARACTERISTICS OF EMULSION FAT AND FLOUR MIXTURES DURING STORAGE

Indicators	The value of the quality indicators of the emulsion mixture prepared		
	withoutadditives (control)	withaddition	
		MF	MZHT
Consistencyat18^{0}C	fusible, plastic, dense,		
	homogeneous	with slight dark inclusions (grain shells)	
Cutsurfacecondition	Weakly shiny, dry to the touch	Matte, dry to the touch, dense	
Color	Lightcream, uniform	Creamy, uniform	
Smellandtaste	peculiar, without foreign smell and taste	peculiar, with a mild powdery odor and sweet aftertaste	
Signs of damage to products, after, days.:			
15	-	++	-
45	-	+++	-
60	-	-	+

Symbols: + - weakly expressed; ++ - rancid taste and unpleasant smell; +++ - rancid taste, unpleasant odor, the formation of pigment spots on the surface of the product.

The use of flour from cakes of the studied raw materials had a certain effect on the organoleptic properties of fat and flour mixtures.[30-32]

An analysis of the experimental data showed that the emulsion fat and flour composite mixtures containing additives up to 10.0% by weight of fat, inclusive, meet the requirements for spreads in terms of organoleptic indicators, and can be used both for direct consumption and for baking flour products.

It follows from the results of the studies that in order to obtain high-quality emulsion products based on fat, it is necessary to take into account a number of indicators, covering, in addition to purely technological properties (hardness, melting and pour points), microbiological and product spoilage indicators (acid, peroxide and anisidine numbers).

Thus, the effectiveness of the proposed mode of preliminary heat treatment of flour from sesame cake or sunflower seeds has been established. The use of these additives in their natural form, not subjected to preliminary pasteurization, as a prescription component of emulsion fat and flour composite mixtures, leads to a sharp increase in the biomass of microorganisms, including molds and yeasts, which is one of the main causes of product spoilage and a reduction in its shelf life to 15 days. The optimal shelf life of the mixture with pasteurized additives is 30 days, the permissible one is 45 days.

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