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Research of Vegetable Oils Oxidation Process in the Deep Fat during Thermal Treatment.

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ABSTRACT

Change of deep fat quality indexes significantly influencesthe formation of consumer properties of fried products, and correctly matched fat raw materials guarantee its quality and safety. In this paper the analysis of vegetable oils use prospects (sunflower, palm, rapeseed, corn, linseed, mustard) as deep fat was carried out. For an assessment of the oxidizing processes, which occur in the deep fat at heat treatment, peroxide, iodine and acid index values were chosen. The analysis of organoleptic, physical and chemical indexes of the studied vegetable oils and the deep fried production showed usefulness of mustard and linseed oils as deep fat for not more than 1 h usage, sunflower and corn – not more than 2 h, and palm and rapeseed – not more than 3 h. Besides, it was revealed that use of rapeseed oil slows down the process of deep fat thermal oxidation. Thus, decrease in rates of primary products of oxidation formation was observed, as well as reduction in the number of secondary oxidation products. At the same time it was noted that the use of rapeseed oil makes it possible to reduce the specific consumption of deep fat, as well as to extend its continuous use while maintaining the organoleptic characteristics of the fried products.

Keywords: vegetable oil, oxidative processes, peroxide value, iodine value, acid value.

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INTRODUCTION

In today's world, there is an increasing attention to a healthy lifestyle, the integral part of which is a balanced diet, since it is proven that unbalanced diet contributes to the development of serious diseases. As it is known, vegetable oils are one of the staple foods, which account for about 30% of the total caloric intake. Edible vegetable fats are characterized not only by higher energy value, but also contain valuable biologically active substances, necessary for normal functioning of the human body: essential fatty acids, phospholipids, sterols, as well as some fat-soluble vitamins. In addition, they improve the organoleptic indexes of food products, providing a feeling of fullness [1].

Today such type of vegetable oils thermal culinary treatment in the process of deep-fat frying enjoys increasing popularity.Change of deep fat quality indexes significantly affects the formation of consumer properties of fried products, and it is correctly matched fatty raw materials that guarantee its quality and safety [2].

The objective of this paper was to estimate the prospects of vegetable oils use (rapeseed, sunflower, corn, linseed, mustard, and palm) as deep fat based on the analysis of their oxidation indexesdegree during high temperature treatment.

OBJECTS AND METHODS OF RESEARCH

The main objects of research: sunflower (GOST R 52465-2005), palm (GOST 53776-2010), rapeseed (GOST 8988-2002), corn (GOST 8808-2000), linseed (GOST 5791-81) and mustard (GOST 8807-94) oils, which were continuously used for 4 hours of frying test batches of semi-finishedproducts at 160-170 ° C for 2-3 min. Peroxide number (PN) of vegetable oils was determined according to GOST 51487-99; iodine number (IN) - GOST 5475-69; acid number (AN) - GOST 5476-80.

Deep-fat frying products were developed on the basis of the initial recipe for national flour confectionery product "Chak-Chak" [3] which was analyzed according to physical and chemical parameters: humidity (GOST 5900-73) and fat mass fraction (GOST 5899-85).

RESULTS

Thermal processing of vegetable oils was accompanied by profound changes in the deep-fat: the formation of essential fatty acids oxidation products that contribute to the deterioration of organoleptic indexes and reduce the nutritional value of the product, as well as had a negative impact on human body, causing serious diseases of our time. At present, research to study the chemical changes taking place in the frying oils during frying are very much relevant.

The possibility of using vegetable oils as a deep fat was empirically determined by the combination of organoleptic, physical and chemical, and technological parameters.

The paper explored the possibility of using vegetable oils: rapeseed, sunflower, corn, linseed, mustard, and palm as a deep fat in the production of national flour confectionery of Tatar cuisine. Used frying oils contain valuable biologically active substances, which are easily absorbed by the human body [4].

In the continuous heat treatment for 4 hours was observed the change in organoleptic indexes, both of the vegetable oils and fried products. The samples of mustard and linseed oils, as well as semi-fried products were characterized by deterioration of organoleptic indexes after 1 h of heat treatment, the samples of sunflower and corn oils - after 2 hours, palm and rapeseed oils -after 3 hours, probably due to the qualitative composition of triglycerides.

However, organoleptic indexesalone do not give the full opportunity to evaluate the fitness of vegetable oils used as deep fat. In this paper for the study of oxidation processes that occur in oil during heat treatment were selected the parameters ofperoxide, iodine and acid values.

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As seen in Fig. 1, the highest indexvalue of peroxidation, which determines the number of primary oxidation products, is typical for sunflower and corn oils which contain polyene fatty acids, the most sensitive to oxidative influence. The lowest final index value correspondsto linseed oil (1.6 mmol (1/2 O) / kg), containing a large number of carotenoids possessingantioxidant activity [5]. Furtherdepending onperoxidation value increase followed palm (2.6 mmol (1/2 O) / kg), rapeseed (2.8 mmol (1/2 O) / kg), mustard (2.9 mmol(1/2 O) / kg), corn (4.7 mmol (1/2) O / kg) and sunflower (8.5 mmol (1/2 O) / kg) oils.

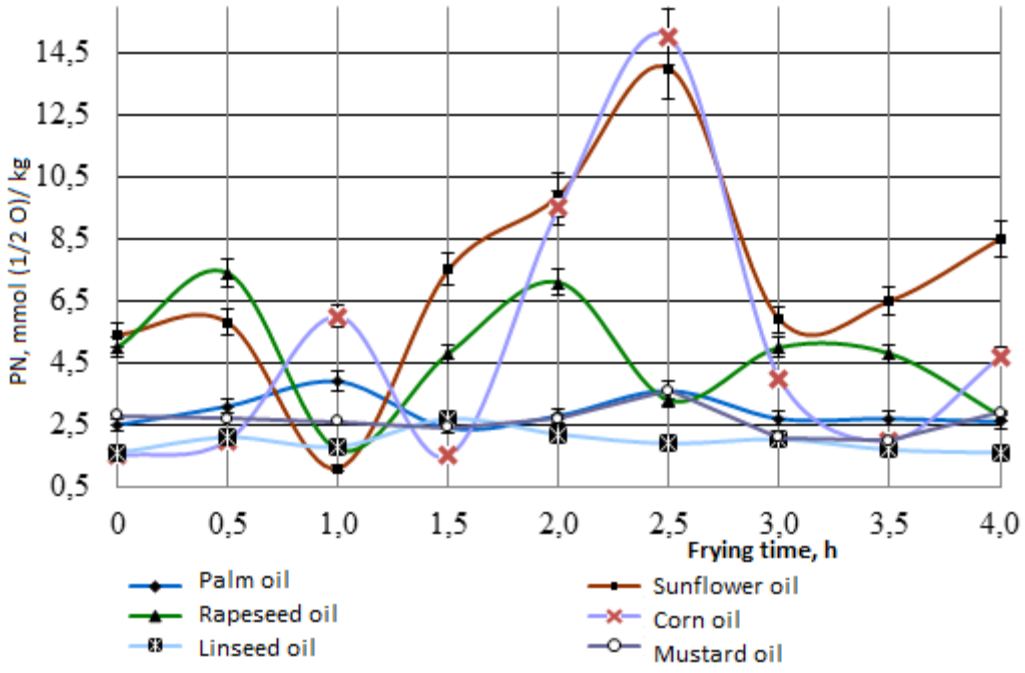

Figure 1: Change in index values of deep fat peroxide number

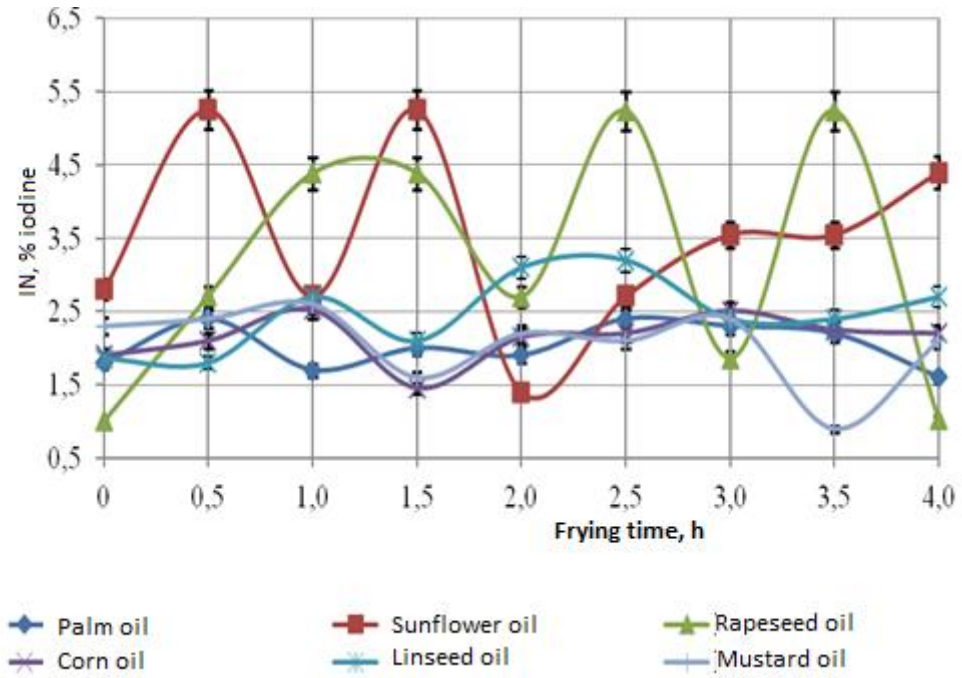

Figure 2: Change in index values of deep fat iodine number

It is known that iodine value reflects the degree of fatty acids unsaturation and characterizesthe stability of frying oils to thermal oxidation. Sunflower oil has the highest index value of iodine number (2.8 and 4.5 mgJ2, respectively,) at both the beginning and the end of thermal oxidation (Fig. 2), while the composition

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of sunflower oil contains more than 50% of polyunsaturated fatty acids [6]. The most resistant to oxidation appeared to be rapeseed and palm oils having the lowest initial and final index values.

Phasic nature of peroxide number value change at 4 h flour products heat treatment allows to conclude that the formation of secondary oxidation products, as evidenced by the change in the acid number, quantifies the presence of free fatty acids [5].

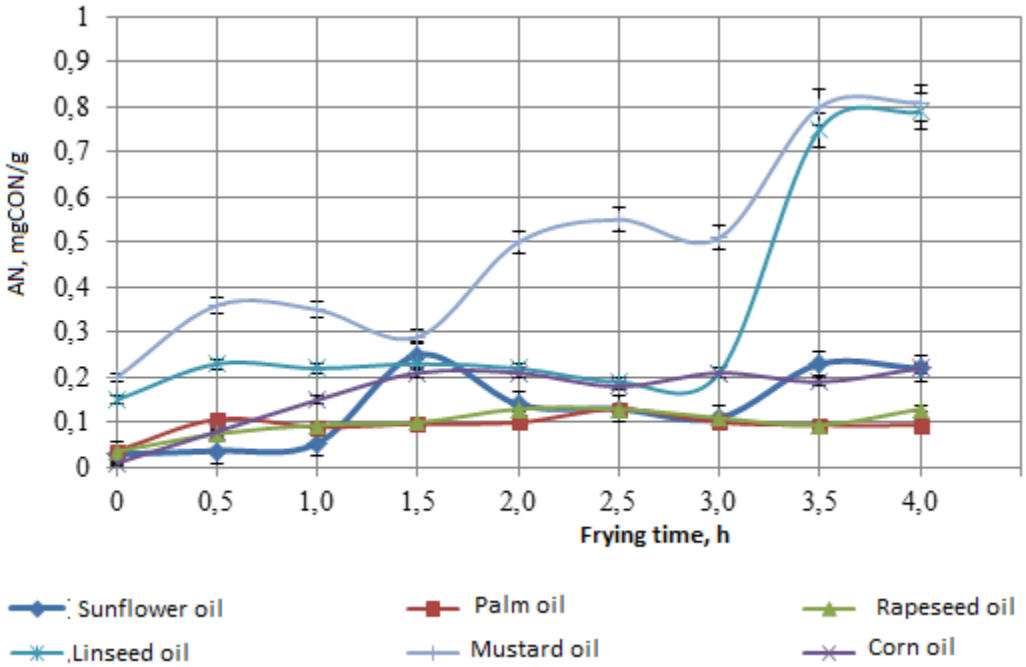

Figure 3: Change in index values of deep fat acid number

As seen in Fig. 3 during 4 h heat treatment was typical the increase in the acid number of linseed and mustard oil by 4.5 and 3 times, respectively, compared to the original value. For the rest of the studied vegetable oils the increase of this index was insignificant. Possibly, the increase in vegetable oils' acid number is due to the flour products' high moisture content, which could cause a significant acceleration of deep fat hydrolysis process [7].

Today is urgent to study the degree of deep fat products oil absorption during heat treatment [2]. Further investigation was directed on determining the specific consumption of deep fat at 4 hours of thermal treatment. Based on the data presented in Table 1, it can be concluded that the lowest consumption of deep fat was noted when using rapeseed and palm oils. Flour products fried in linseed oil were characterized by the highest content of fat (31.7%) and worsened organoleptic properties. Was marked [8] the slowdown in the process of heat treatment at high absorbency of frying oils by flour confectionery, which correlates with the presented in this paper results.

Table 1: Quality indexes of deep fat and fried products

Name of the index	Vegetable oils					
	sunflower	palm	corn	rapeseed	mustard	linseed
Specific consumption of fat, g fat / g of flour products	0.36±0.01	0.33±0.02	0.38±0.01	0.31±0.01	0.42±0.03	0.48±0.02
Flour products fat content,%	24.6±0.3	22.0±0.1	24.9±0.5	22.1±0.1	24.1±0.2	31.7±0.2
Flour products moisture content, %	6.5±0.1	7.9±0.2	6.6±0.1	7.3±0.1	6.5±0.3	4.4±0.1

SUMMARY

Analysis of organoleptic, physical and chemical indexes of investigated oils and fried products showed the usefulness of mustard and linseed oil as deep fat for not more than 1 hour of usage, sunflower and corn - not more than 2 hours, palm and rapeseed – not more than 3 hours.

The studies found that the use of rapeseed and palm oil slows down the process of deep fat oxidation. At the same there was observed a decline in the formation of primary products of oxidation and reduction in the number of secondary oxidation products.

The paper shows that during the preparation deep-fat frying products using rapeseed oil allows to reduce the specific consumption of deep fat to 7-35% in comparison with other oils at simultaneous increase in its period of continuous use up to 3 hours. In addition, to date, due to the increased canola acreage and volumes of its processing in the territory of the Republic of Tatarstan, rapeseed oil is becoming one of the most available and promising fat products.

CONCLUSION

Based on the analysis of vegetable oil oxidation degree (rapeseed, sunflower, corn, linseed, mustard seed, and palm) during high temperature treatment was displayed perspective of rapeseed oil application as deep fat.

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