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Investigation of physicochemical properties of table margarine during storage time in ambient temperature

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ABSTRACT

In this study table margarine was made based on palm and soybean oil oils and storage in ambient temperature for 90 days, each 15 days sampling was down and its physicochemical properties were investigated. Except of peroxide value all of measured factor was within the standard limit. Peroxide value of the produced samples increased significantly over storage and reached to2.24 meq/kg at 75 d indicating a high level of oxidation thus according to national standard the samples were not acceptable.

Key words: Table margarine, peroxide number, storage time, ambient temperature.

INTRODUCTION

Margarine is an imitation butter spread used for baking, spreading, and cooking. Originally, it was created as a substitute for butter from skimmed milk and beef tallow in 1869 by Hippolyte Mège-Mouriès in France. Today's margarine is produced mainly of refined plant oils and water, like butter, Margarine, consists of a water-in-fat emulsion, with very small droplets of water dispersed completely throughout a fat phase to formation stable crystalline form. The basic method for margarine production, consists of emulsifying a blend of vegetable oils, which can be modified using interesterification, fractionation, and hydrogenation, with skimmed milk, salt, essence and preservative, chilling the mixture to solidify it and working it to create suitable texture [1]. Today's, due to the change of peoples life style and increasing the urbanization the cardiovascular dieses was increased. Therefore reduction of animal fats and on the other hand, production and consumption of vegetable fat was suggested. So Consumption of margarine is increasing trend. For example, in 1930, in the United States, , the average person consumed 8.2 kg /year of butter and just over 0.91 kg of margarine. By the end of the 20th century, average consumption for butter and margarine reached to 2.3 kg 3.6 kg[2]. Due to the high fat content of margarine storage condition especially temperature was important an directly affected the shelf life. So the objective of this study was, made a kind of table margarine including palm and soybean oil and investigates its quality during 90 days of storage in ambient temperature.

MATERIALS AND METHODS

Table margarine with defined formulation (Table 1) was produced. Potassium sorbat and citric acid were purchased from Aryan shimi Co. Butter essence, Firmenich brand, Swiss, ordered by Nasim–e–Sabah Co., glycerol mono-stearat, china, ordered by Pars Behbood Asia Co., iodine – less salt, Iranian salt purification food & industry co., and non-fat milk powder, Zarrin shad food industries co., were purchased.

Margarine production

water soluble component such as potassium sorbate, milk powder , sodium benzoate and salt are solved in some water, then pasteurize (75ºC for 15 S) after that temperature was decreased to about 35-40ºc . Oil phase is heated to reaching 5º above melting point of the used emulsifier and mixed with oil soluble ingredient. oil and water phases are mixed to formation of margarine emulsion. Finally sensitive substance such as citric acid essence and vitamins are added. Then they pass through Voteitor by high – pressure pump and then stored at 25ºC for 90 days. For analysis each 15 days sampling was done.

Methods

Measurements of peroxide value, acid value salt content, melting point, refraction index, iodine value, and moisture content were performed according to national standard No. 4179, 4178, 87981, 4887, 5108, 4886, 7513, respectively.

Data Analysis

Data collected from the study samples were analyzed based on 0.05% coefficient of error by a software program. The data analysis was performed using MINITAB statistical software, release 14.2 (MINITAB Inc., state college, PA and USA). At first such software program proved samples normal conditions and then the significant difference among data was precisely studied via Anova –one – way test and p-value was determined.

RESULTS AND DISCUSSION

The results of testing the table margarine sample stored at 25ºC for 90 d are presented in Table 1. All types of oil contain certain insignificant amount of free fatty acid; however, it may exceed a certain level due to the activity of spoilage factors and hydrolysis reaction. The presence of moisture in the product accelerates the hydrolysis reaction. Therefore, acidity is among the indices helping to identification of rancidity in oils and fats. Because of using emulsifiers in margarine high content of water in the formulation is possible. The moisture content did not show any changes over storage, being on average ~ 19.10% The acidity significantly increased (p<0.05). Acidity level increased significantly from 0.13% at 15d to 0.15% at 60d. It exhibited a rising trend as ultimately reached 0.15% at 90d. This difference, however, was not significant as compared to 60d. It is worthy to note that acid value was still within the national standard range despite as significant increase. Gan *et. al*., (2004) reported similar results. They examined the variations of palm oil over storage at 28ºC and stated that acid value increased significantly to 15% following 52d of storage at 28ºC. Fats oxidation is among the most important causes of nutrients deterioration. Oxidative degradation of oils results in developing undesirable smell and taste as well as partial or whole destruction of vitamins or other nutrients via chemical intermediates in different steps of oxidation. In the initial step, O2 molecules along with unsaturated fatty acids generate Hydroperoxide and free radicals. Peroxide is the primary product of oxidation of fatty matters and an indicator of oxidative degradation. Peroxide value of the produced samples increased significantly over storage. According to national standard, peroxide value of table margarine must not exceed 2 meq/kg. It was measured 2.24 meq/kg at 75 d indicating a high level of oxidation thus the samples were not acceptable from 75d (5meq/kg). In general, high temperature accelerates many reactions including oxidation. Since the samples were kept in ambient temperature, an increase in peroxide value was predicted. Azarifar et. al., (2010) produced different margarine samples and investigated their peroxide values at 23C in different time intervals. The results showed 23C for 14 d increased its peroxide value from 0.25 to ~0.6. When the oxidation reactions precede its products such as hydroperoxide, aldehyde, ketone, etc. accumulate resulting in accelerated oxidation reactions. Also longer storage time, especially at high temperature results in decomposition of antioxidants in the oil. Oxidation is accelerated by two factors namely the oil stability against oxidation is reduced. The stability of the produced sample showed a significant decrease over time as it was significant in all studied time spans as compared to previous or next periods except for 75 and 90d. for instances the stability of table margarine at 15, 30, 45, 60, 75 and 90d was 14.78 , 9.54 , 7.41 , 6.11 , 2.82 and 5.5 h, respectively (p<0.05). It should be noted that the stability of margarine was 18.25 h upon manufacturing being significantly higher than that of 15 d (p<0.05). Abromoviet *et. al*., (2005) examined the variations occurring in oil and reported similar results.

The factors affecting melting point of oils include double band, chain length cis and trans structures conjugated and unconjugated structures, the composition of fatty acids and the compounds generated in oil. Slip point of the produced table margarine showed a significant increase over storage as it increased from 35.2 °C at 1 d (data not shown) [12] to 36.24ºC at 30d and ultimately to 37.63C however it was not significantly different as compared to 60 and 75 d (p>0.05). As previously stated, different reactions notably oxidation occurs at high temperature resulting in generation of new compounds affecting the melting point as was observed here. A significantly rising trend was observed for iodine number over storage as it increased from 66.5 at 15 d to 69.11 at 90d (p<0.05). Refraction coefficient of a matter is defined as the ratio of light velocity in vacuum to its velocity in the matter. Each type of oil has specific refract index depending on its saturation degree while affecting the level of oxidation and heat

treatments. Refract index of the produced samples did not show any variations over storage, however other results revealed the oxidation of the samples, because generally the variations of refract index is trivial and it would change when strong deterioration occurs in oil.

Table 1- Formulation of produced table margarine

Ingredient	Table margarine
Salt	6600 g
Potassium sorbet	1950 g
Sodium benzoate	1050 g
Milk powder	25 kg
Mono glyceride	12 kg
Citric acid	900 g
Butter essence	750 g
Water phase	600 kg
Oil phase (75% palm olein – 25% soybeen)	2400 kg
Total	3000 kg

Table 2- Physicochemical properties of the produced table margarine

Table margarine	15 day after production	30day after production	45 day after production	60 day after production	75 day after production	90day after production	Accepted limit
Moisture (%)	19.17±0.82 [a]	19.12±0.72 [a]	19.07±0.67 [a]	19.10±0.57 [a]	19.13±0.60 [a]	19.17±0.62 [a]	Max 16
Peroxide value (meq/kg)	0.45±0.05 [a]	1.03±0.03 [b]	1.23±0.03 [b]	1.73±0.03 [b]	2.24±0.12 [c]	2.74±0.07 [c]	Max 2
Acidity (% oleic acid)	0.13±0.01 [a]	0.14±0.03 [ab]	0.14±0.02 [ab]	0.15±0.01 [b]	0.15±0.04 [b]	0.16±0.05 [b]	Max 0.30
Preservatives (sorbic and benzoic acids) (ppm)	503.21±19.51 [a]	509.42±7.51 [a]	512.10±8.21 [a]	507.12±6.20 [a]	509.71±11.40 [a]	506.71±13.48 [a]	Max 1000
Slip point	35.5±0.28 [a]	36.24±2.21 [b]	36.63±1.3 [b]	36.92±1.13 [bc]	37.02±1.25 [c]	37.63±1.3 [c]	Max 37
Refraction index (40ºC)	1.4596±0.01 [a]	1.4598±0.00 [a]	1.4596±0.01 [a]	1.4596±0.01 [a]	1.4596±0.01 [a]	1.4597±0.00 [a]	-
Iodine value	66.5±3.24 [b]	67±2.34 [b]	67.82±2.08 [b]	68.30±2.08 [bc]	68.71±1.89 [c]	69.11±0.01 [c]	-
Resistance / h (Rancimate at 110ºC)	14.78±0.78 [b]	9.54±0.65 [c]	7.41±0.41 [d]	6.11±0.41 [e]	5.82±0.32 [f]	5.02±0.32 [f]	-

CONCLUSION

As the results showed storage of margarine at high temperature results in undesirable reactions and rancidity even under acceptable manufacturing conditions. Oxidation reactions considerably increase upon storage for 75 d that such margarine would not be according to national standard. Thus cold – chain storage and distribution for margarine is recommended.

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