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Uses of margarines, consumption rates of margarine, oxidative deterioration and storage conditions, the relationship between spices and antioxidants - A Review

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Abstract

Margarines are of great commercial importance and are used in many sectors. The vegetable oil used for margarines affects this composition. Sodium is present in the composition of margarine. This sodium content poses a risk, and margarines have a proven association with an increased risk of cardiovascular disease. This is triggered by the sodium it contains. Curiosity has increased with the conscious society. New laws are being enacted on margarines and new studies are being carried out. It is aimed to increase the content of phenolic compounds and antioxidants by changing the sodium content and adding antioxidant source spices accordingly. The fatty acid composition, solid fat content, consistency and melting point of the oils used in margarine determine their functional properties. However, issues with high levels of trans fatty acids (TFA) and saturated fatty acids still pose a challenge in the formulation of this product category. In this seminar, it is aimed to present the change when the sodium content in margarine is reduced and spices are added by specifying the composition, storage conditions, and place in the legislation of margarines.

Keywords: Antioxidant, phenolic compound, cardiovascular disease, Margarine, sodium

1.Introduction

The first margarines were made in 1869 by the French chemist Hippolyte Mege Mouries [1,2]. It came from a competition organized by Napoleon (1808-1873) during the Franeo-Prussian War of 1870 [1], when France was facing an economic crisis and some food shortages and was losing a war [3]. Margarines are considered to be water-in-oil emulsions. In butter and margarine, water droplets are surrounded by fat. They have been introduced to the market as an economically viable alternative to butter [4]. The name "margarine" comes from the Greek phrase "margaron", meaning "pearl white" [5]. It is also derived in other languages, such as "margarina" in Italian and margarine in English. The first company to produce margarine was the Dutch company Jurgens [2]. Since its inception, margarines have been produced in many other forms to improve their functional and sensory properties. There are solid forms.

There are many different ways to improve margarine, such as the addition of coconut oil, the development of modern emulsifiers (monoacylglycerols and diacylglycerols), the replacement of coconut oil with cottonseed and soybean oil [1,7]. The aim of this study was to compile detailed information about uses of margarines, consumption rates of margarine, oidative deterioration and storage conditions, the relationship between spices and antioxidants.

Content of margarines

Low-fat paste with margarine consists of an aqueous phase dispersed as fine droplets in liquid oil stabilized in a network of solid fat crystals [8]. According to Turkish legislation, margarine contains 80% ≤ Fat≤ 90% fat. In three-quarter fat margarine, the fat content is 60% ≤ Fat≤ 62% [9]. Spread products usually contain less than 30%-70% liquid/solid fat [10]. On the other hand, margarine can be defined as a product containing 10-90% fat, depending on the legislation of the country where it is marketed.

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Since their invention, margarines have undergone changes in their composition and processing resulting in different products. The first margarines were prepared with beef tallow. As time progressed, modifications of vegetable oils were developed and then bovine tallow was used [11].

In recent years, oils obtained from partial hydrogenation of vegetable oils have been used, which makes it possible to obtain solid oils at room temperature [12]. However, the discovery of health effects related to trans fatty acids (TFAs) formed during this hydrogenation process has also led to a number of studies on their replacement [13]. In May 2018, the World Health Organization (WHO) launched a series of actions to support governments in removing industrially produced Trans Fatty Acids from the global food supply by 2023 (WHO, 2019).

Table 1. Composition of a typical margarine [14].

Typical Margarine Product Composition
Oil Phase
Aqueous phase (Water/oil protein)
Salt
Emulsifier systems
Preservatives/additives
Color/flavor
Vitamins

Interesterified fat is the main source of lipids used in margarines at this time and is a fat modification technique. It is the process of intramolecular and intermolecular dispersion of fatty acids without modification of the fatty acid chain in the presence of a catalyst. There are still some fat modifications for margarines aimed at making the margarine product healthier [11,15,16,17]. An alternative to make it healthier is to replace fats with structured vegetable oils defined as organogels [18]. The types, lipid content and properties of margarines are modulated according to the desired application. Margarines with lower lipid content tend to be softer and more spreadable. It was created for application in bread and biscuits. Those with a much higher lipid content are harder, have higher melting points and are mainly used in cooking and baking [19]. Soft type margarines are packaged in plastic containers. It can be stored under refrigerator conditions. Block margarines are packaged in containers. It has a much firmer consistency. Bakery margarine, on the other hand, mostly does not require refrigeration, and its formulation is designed to withstand the work of the dough, creating a cry [20].

Table.2 Comparison of soft margarine and solid margarine [19,20]

Soft Margarine	**Solid Margarine**
It has a lower lipid content.	It has a higher lipid content.
Tends to be spreadable.	It has a firmer consistency.
Applied to bread and biscuits.	It is used in cooking and baking.
Packaged in plastic containers.	Packaged in containers.

Types of margarines

According to TGK 2008 Spreadable fats/margarine: They are basically water-in-oil emulsions derived from vegetable or animal fats or milk fat suitable for human nutrition. The group of formable products that may contain milk, dairy products, spreadable oils that may contain milk fat at a maximum of 3% of the total fat content are named according to their total fat content upon introduction to the market;

Margarine: A product with a fat content of at least 80% and at most 90% by weight

Margarine, three quarters fat: A product with a fat content of at least 60% and not more than 62% by weight.

Margarine, half fat: A product with a fat content of at least 39% and at most 41% by weight, Fat content of at least 10% by weight and less than 39% - Fat content of more than 41% by weight and less than 60% by weight – Fat content of more than 62% by weight and more than 80% by weight, Spreadable oils containing at least 10% and up to 80% milk fat of the total fat content are named according to their total fat content upon introduction to the market.

Milk fat margarine: A product with a fat content of at least 80% and not more than 90% by weight,

Milk fat margarine – three-quarters fat: A product with a fat content of at least 60% and not more than 62% by weight

Milk fat margarine – Half fat: A product with a fat content of at least 39% and at most 41% by weight,

Milk fat margarine – "….%" fat: Products with a fat content in the following proportions by weightFat content of at least 10% and less than 39% by weight

Fat content more than 41% and less than 60% by weight

Fat content more than 62% and less than 80% by weight

Dense oil: A product with a fat content of more than 90%,

Flavored spreadable oils/margarine: Refers to the product obtained by seasoning all products within the scope of the mentioned Communiqué with various spices and vegetables, honey or other foodstuffs provided that they are not adulterated by imitation and adulteration, and which has the characteristics of the products within the scope of the Communiqué in terms of taste, smell, appearance and characteristics other than structure [9]. These products should have a unique taste, smell and appearance. At least 2/3 of the part of the products other than salt and water should be oil. Fat ratios are shown in Table.3.

Table 3. Fat ratios of margarines by weight [9].

Product name	Fat content by weight
Margarin	%80 ≤ Fat≤ %90
Three-quarter fat margarine	%60 ≤ Fat ≤ %62
Half-fat margarine	%39 ≤ Fat ≤ %41
Margarine - "%...." fat	%10 ≤ Fat < %39 %41 < Fat < %60 %62 < Fat < %80

Uses of margarines

Margarines are examined in 3 groups in terms of their usage areas; breakfast, kitchen and food industry margarine [21]. It is possible to classify margarines as breakfast margarines and margarines used in food and industrial products [22]. The annual per capita consumption of margarine in Turkey is 2.2 kg Baltacı, Köksal and Beyhan stated that liquid fats (olive oil and other vegetable oils) and solid fats (butter, margarine) should be consumed in balance. Sözen et al. found that the rate of solid margarine consumption was 6.2% and the rate of soft margarine consumption was 7.9% in 278 workers working in a workplace in the metal sector [23,24,25,26,27]. Margarine consumption rate was given in Fig.1

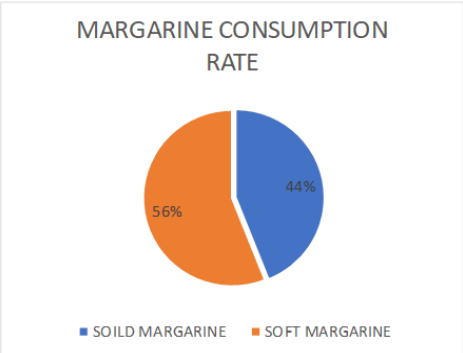

Figure 1. Margarine consumption rate [27].

Margarine production

Margarine production consists mainly of oil phase preparation with water, emulsion preparation, cooling, crystallization, kneading and packaging/maturation. For many consumers, the textural (hardness) properties of margarines are an important factor affecting their performance in the final product [28]. Conventional margarine production is the process of converting solid or semi-solid fats into a stable emulsified system with spreadable properties [29]. After these steps, the final product may be modified to improve its physicochemical, sensory and nutritional properties depending on the fat used, the type of margarine and the desired properties. It can be in the form of spice addition, vitamin addition, etc. Among the vegetable oils used in margarine production, palm oil is the most preferred due to its advantageous properties such as plasticity at room temperature, high thermal and oxidative stability and high productivity at low price [28,30]. Our body's main energy sources are carbohydrates, proteins and fats, which are the building blocks of food. Margarines contain the main source of energy for the body. It makes it easier for the body to absorb vitamins A, D, E and K and carotenoids, which are soluble only in fat. However, vegetable oils are particularly poor in vitamins A and D. Margarines are important sources of vitamins A and D compared to liquid fats. It is especially important for the healthy growth and development of children because it contains omega-3 and omega-6 fatty acids that are not produced in the body and must be taken from outside. However, margarines made from vegetable oils are important in the diet. In fact, it has the advantage of being higher in monounsaturated and polyunsaturated fatty acid content than butter and does not contain cholesterol, and is increasingly becoming a part of life [31]. Nowadays, as a result of the growing interest in functional foods that can contribute to consumer health, there is a growing trend to enrich this product with additives that appear to be cardiovascularly beneficial, such as phytosterols and polyunsaturated fatty acid groups [32] ,and studies are being conducted on this [33].

Consumption rates of margarine

In a study, a study was conducted on the factors affecting margarine consumption in a local market in Konya. In the model, independent variables explain 19.6% of the dependent variable.

It is determined that there is a positive and statistically significant relationship between place of birth, high income group, household size and household expenditure and margarine consumption tendency of consumers. There is an inverse and statistically significant relationship between gender and low income and margarine consumption tendency [34].

Oxidative deterioration and storage conditions

Because of their high fat content, margarines are susceptible to chemical spoilage [35]. Oxidation leads to rancidity, reduced nutritional quality and the formation of harmful compounds in food. Oxidation is the main cause of spoilage of many fat-containing products such as margarine. Margarines are subjected to long storage conditions, light and oxygen, etc. Due to the oxidation of unsaturated molecules in its composition, the formation of peroxides and the formation of aldehydes in the later stages creates an unpleasant flavor. In addition, the composition of the vitamins in it deteriorates. However, attention should also be paid to the storage conditions of margarines. In a study, breakfast and kitchen margarines of different brands were stored at temperatures between 4 and 25°C for 12 weeks. Observations were made by taking samples every 2 weeks. It was aimed to evaluate the oxidative stability of margarines by determining the changes in tocopherol contents, peroxide numbers, TBA (Thiobarbituric acid) values, conjugated-diene and fatty acid compositions.

Thiobarbituric acid (TBA) determination is generally applied in foods and other biological systems to determine the degree of oxidation of fats. It is applied to determine the degree of oxidation of fat. As a result of this study, the peroxide numbers determined in all margarine samples before storage were within the limits specified in the legislation. PS was lower in culinary margarines than in breakfast margarines. This is due to the unsaturated fatty acid content of the margarine groups. The increase in conjugated-diene was higher in breakfast margarines in parallel with the increase in PS. Conjugated-diene values were lower in kitchen margarines compared to breakfast margarines. This may be due to the higher saturated fatty acid content of kitchen margarines compared to breakfast margarines. During storage, TBA value increased more in breakfast margarines than kitchen margarines. In this case, it can be said that the total unsaturated fatty acid content of breakfast margarines is about twice as high as that of kitchen margarines. It was determined that margarines had different tocopherol contents and amounts. In all margarine samples, total tocopherol content decreased as storage time and storage temperature increased. More tocopherol loss was found in margarines stored at 25°C depending on time. It was determined that the appropriate storage condition for margarines was 4°C, while deterioration started from the first week of storage at 25°C. This study emphasizes the need to pay attention to temperature during storage [36].

The relationship between spices and antioxidants

The word 'spring' means 'odor' in Arabic and the plural word 'spice' means 'odors' and in Turkish, spice is called 'issı ot' [37]. However, in addition to being flavor enhancers and food preservatives, spices have also reported bioactive properties of different spices indicating that they may play a role in preventing chronic non-communicable diseases [38]. Throughout its history, it has been called 'light in burden, heavy in cost' [39]. Spices, which are mostly used in foods for flavoring purposes, have recently increased their shelf life by protecting foods especially with their antimicrobial and antioxidant effects. Today, due to the increase in the potential demand for the consumption of minimally processed foods that do not contain any additives, the use of spices and extracts for preservation purposes in foodstuffs has also increased [40].

The term antioxidant is used for compounds that prevent or delay oxidative deterioration and this term can be expressed more broadly as substances that react with oxygen in foods and prevent negative effects in foods [41,42]. Spices rich in phenolic and flavonoids have strong antioxidant (oxidation inhibitor) effects. Daily consumption of spices at certain ratios also supports the antioxidant activity required by the body [43]. Antioxidants delay or inhibit cellular damage, mostly due to their free radical scavenging properties [44]. These supplements are of great importance to prevent premature aging, protect against cancer and other diseases and increase the body's resistance [43].

Sodium content and antioxidant additives in margarine

The element with the chemical symbol Na is called sodium**.** High consumption intake is found to benefit from transport and use, which are the leading causes of death worldwide [45]

Hypertension affects approximately 25% of the adult population and its estimated prevalence is 60% by 2025. Although found naturally in many foods, most of the sodium in the diet comes from table salt (NaCl), sodium compounds added during food processing [46,47]. Spices contain natural chemical preservatives such as vitamins A, E and C, as well as phenolic elements with antioxidant capacity. Antioxidants, geometric systems are a protective view against the harmful effects of free radicals. Radicals that are not properly neutralized can initiate oxidative stress damages in nuclei and tissues, leading to various fragments such as neurodegenerative and developmental groups, cancer and premature aging. The action of antioxidants can be inhibitors of free radicals, scavenging agents of metals, inhibitors of oxidative enzymes or cofactors of selenium [48]. Spices and their extracts are gaining increasing attention in food, as they effectively slow the oxidative degradation of lipids and benefit the quality and nutrient consumption of the food they add [49]. A research process, spreading A (scallion, garlic, marjoram, and oregano) and B (lemon, thyme, basil, and thyme) spice blends allowed for up to 75% and 50% sodium to pass through, respectively, while enhancing naturalness. enjoying sensory appeal. In addition, an important myth was observed in the antioxidant activity of margarine with the addition of lemon, thyme, basil and thyme spice mixture. Spice mixes A and B added significantly increased the total defences of margarine preserves, but the effect was more pronounced for mix B. Considering that when the same amount of spice blend mixed A and B, the antioxidant activity was found to be positive with the phenolic content. When B (1.5 g)/100 g) is added [50], the higher total activity observed for strains containing blend B may reflect many of the antagonists with properties for the observed variants in antioxidant, phenolic content.

Conclusion

Margarines offer a product that can be included in our diet with its valuable fats. There are also nutritional issues involving margarine consumption, such as Trans Fatty Acids (TFA), sodium levels, which are still present in formulations. Despite these problems, the market is still expanding worldwide. Although the market for margarines is expanding, regulations continue to change. However, it is also desired to create an alternative product with better properties.

As described, the addition of antioxidants has an effect on sodium activity. It is an alternative that can be applied both to prevent oxidative deterioration and to increase nutritional value by enriching phenolic compounds and antioxidants.

Compliance with Ethics Requirements: Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human or animal subjects (if exist) respect the specific regulation and standards.

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