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FATTY-ACID COMPOSITION OF IMPORTED NUTS SOLD IN THE MARKETS OF THE CITY OF ASTANA

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Abstract

Nuts are high in protein, unsaturated fats, fiber, vitamins, and minerals. 70-80% of the fatty acids present in nuts and seeds are essential fatty acids, which are components of the plasma membrane and contain lecithin, a lipoprotein found in brain cells. The findings of investigations on the fatty acid makeup of several types of imported nuts in Astana's marketplaces are presented in this article. In this study, using the HPLC method, 17 samples of nuts imported from Uzbekistan, Iran, China have been analyzed. The experimental part was carried out in an accredited testing laboratory of Nutritest LLP, Almaty. As a result of the research, nut samples taken from the Shapagat, Alem, Sharyn, Astanalyk Bazaar, Eurasia-1 markets exceeded the norms of fatty acid composition from 1 to 20% in all samples. In addition, differences were found in the fatty acid profile of nuts of different types and origin. Peanuts from China, for example, have the highest quantities of palmitic acid, whereas cashews from Iran have the highest levels of stearic acid. Almonds also have the highest oleic acid values, while walnuts have the highest linoleic acid levels. These results may be useful in understanding the differences between nuts and choosing the most appropriate options for consumption based on individual needs and nutritional recommendations.

Key words: fatty acid; food safety; import; linoleic acid; oleic acid; polyunsaturated acids; nuts.

Introduction

Today, consumers are interested in a varied and balanced diet. As a result, the inclusion of nuts in the diet has increased dramatically due to their unique nutritional value, distinctive taste, aroma, nutritional properties and beneficial bioactive compounds. increasingly recognized [1].

Nuts are dry fruits with edible seeds and hard shells, with cashew nuts (Anacardium occidentale), walnuts (Juglans regia), almonds (Prunus dulcis), chestnuts (Castanea sativa), pistachios (Pistacia vera), and hazelnuts (Corylus avellana) being the most productive. They are high in protein, unsaturated fats, fiber, vitamins, and minerals. 70-80% of the fatty acids present in nuts and seeds are essential fatty acids, which are components of the plasma membrane and contain lecithin, a lipoprotein found in brain cells.

The ease of transport due to their estimate makes them indeed more prescribed for utilization in all circumstances. In expansion, nut utilization is regularly related with diminished hazard components for unremitting malady due to the composition of greasy acids, squalene, fiber, plant proteins, minerals, vitamins, carotenoids, and phytosterols with potential antioxidant impacts. Inquisitively, most of the cancer prevention agents in all nuts are within the shell, as appeared for almonds and peanuts, and these are misplaced when the skin is expelled. In expansion, in pistachios, most of the cancer prevention agents are crushed when the hard-shell splits [2].

The most commonly consumed are almonds, Brazil nuts, cashews, hazelnuts, pecans, peanuts, pine nuts, pistachios, walnuts and macadamia [3].

Due to their nutrient-rich composition, nut consumption has been associated with several health benefits such as improved lipid profile (lower cholesterol and triglyceride levels), improved endothelial function and overall cardiovascular health, reduced glycemia and insulin resistance, diabetes prevention and delayed age-related cognitive decline [4].

The fatty acid composition of almonds is another noteworthy aspect, characterized by a substantial presence of monounsaturated (MUFA) fats at approximately 60%, along with polyunsaturated (PUFA) fats at around 30%. This composition predominantly encompasses oleic, linoleic, palmitic, or stearic acids [5, 6]. Summo et al.'s research further highlights the influence of genetic makeup on the fatty acid profile. While the essential fatty acids remain consistent across the examined varieties, variations can be identified in the individual quantities of each fatty acid, as well as in the cumulative content of unsaturated (mono- or polyunsaturated) and saturated (SFA) fractions. The polyunsaturated fatty acids in almonds not only give them nutritional value, but also make them more prone to self-oxidation, which speeds up spoilage and shortens shelf life. Thus, high levels of linoleic acid may indicate almond spoilage. For this reason, one of the most important quality indicators is the ratio of oleic and linoleic acids; high values of this ratio provide stability in oils and better nutritional value [7].

Cashews play a highly significant role as a nutritional source of fats, constituting approximately 47% [8] of their composition. Within cashews, there are 11 saturated fatty acids, amounting to 25.37% of the total content, featuring palmitic acid (12.20%), stearic acid (11.30%), arachidic acid (1.07%), and behenic acid (0.22%). Additionally, cashews consist of seven unsaturated fatty acids, which make up 71.98% of the overall content. These include oleic acid (51.47%), linoleic acid (19.66%), palmitoleic acid (0.36%), and eicosanoic acid (0.34%) [9]. Recent research underscores substantial variations in fat content and corresponding fatty acid profiles across different cultivation regions. Rico et al.'s study, examining 11 varieties of cashews, demonstrates that fat content ranges from 45.05 g/100 g in Vietnamese samples to 50.40 g/100 g in Kenyan samples. In terms of fatty acid profiles, oleic, linoleic, and palmitic acids emerge as the primary constituents [10].

Among the array of nut varieties, hazelnuts exhibit a notably elevated fat content, exceeding 60%. Certain scholarly sources even document fat levels surpassing 70%, contingent upon factors such as the specific cultivar or the position of the fruit. The lipid composition within hazelnuts predominantly comprises monounsaturated fatty acids (MUFAs), constituting approximately 80% of the cumulative fatty acid composition, with oleic acid prominently positioned as the predominant individual monounsaturated fatty acid. Additionally, the next significant fraction within hazelnut fat encompasses polyunsaturated fatty acids (PUFAs), primarily attributed to their linoleic acid composition. Nonetheless, certain research studies contend that saturated fatty acids (SFAs) might emerge as the second predominant cluster of fatty acids, influenced by the heightened presence of palmitic acid [11,12].

Like maximum different nuts, pistachios are excessive in fat, with available literature pointing out a value of around 50%, despite the fact that a few varieties may additionally have better fat content material, achieving values of up to 74.15%. Like different nuts, pistachio fat is rich in unsaturated fatty acids, namely MUFAs. This fraction specifically consists of oleic acid with the addition of palmitoleic acid, while the second maximum critical fraction, PUFA, in particular consists of linoleic acid [13]. As for SFAs, the fraction of minor fatty acids consists almost totally of palmitic acid [14].

The fats content of walnuts is very high, with average values that could only be exceeded with the aid of hazelnuts. Even though the fats content material is inside the 60% range, significant differences had been determined whilst comparing types. Values ranged from 49% to 82%. However, as referred to earlier, most reports show a fat cost of round 60%, with some version relying on the cultivar studied. Walnut fats is especially composed of unsaturated fatty acids, namely PUFAs, while MUFAs are the second one most vital type of fatty acids. Linoleic and linolenic acids are responsible for the excessive quantity of PUFAs, with oleic being the primary MUFA. In regards to the content of SFAs, palmitic and stearic acids are found in huge quantities [15,16,17].

Materials and Methods

The following samples were selected for the study: peanuts (China, Uzbekistan), cashews (Iran), almonds (Iran), walnuts (China, Greece, Kazakhstan). In total, 17 samples were examined, harvests of 2021 and 2022 in the markets of the city of Astana.

The experimental part was carried out in an accredited testing laboratory of Nutritest LLP, Almaty.

The comprehensive fatty acid composition analysis was conducted through high-performance liquid chromatography (HPLC) employing an HPLC Water liquid chromatograph (USA), following the guidelines outlined in MVI MN 1364-2000, titled "Methodology for the Gas Chromatographic Determination of Fatty Acids and Cholesterol in Food and Blood Serum." Experimental parameters within the laboratory encompassed a temperature range of 20.5-24.0 °C and a relative humidity range of 70-74%. Subsequent to the analysis, all gathered data underwent necessary adjustments and were subsequently presented as percentage values.

Results

The study analyzed the fatty acids contained in peanuts grown in Uzbekistan. As a result of determining the ratio of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) in peanut samples, it was found that the predominant acid among SFA (17.148%) was (C16: 0) palmitic acid, the content of which amounted to 11.216%. In the MUFA group (41.28%), oleic acid C18:1 prevailed, the content of which was 40.597%. Among PUFAs (41.387%), the proportion of linoleic acid was the largest and amounted to 39.877%.

According to Table 1, analysis of peanuts imported from China revealed that the saturated fatty acid (SFA) content in the sample was 18.931%, with palmitic acid (12.81%) being the predominant acid. At the same time, the proportion of monounsaturated fatty acids (MUFAs) was 40.23%, with similar proportions of oleic acid (39.4%) and linoleic acid (39.27%). Polyunsaturated fatty acids account for 40.835%

The available data indicate that analytical samples of peanuts imported from Uzbekistan and China contain (C16:0) saturated palmitic acid, (C18:0) stearic acid, (C18:1) oleic acid and (C18:2n6c) Linoleic fatty acids above standard values, twice the standard values in all samples.

Saturated fatty acids were mainly composed of 8 components, the total content of which does not exceed 18%. Among the saturated acids, palmitic acid (11–12%) and stearic acid (range 2–4%) were quantitatively distinguished. The remaining carboxylic acids are present in relatively small, sometimes trace, amounts in the oil. Of the unsaturated acids, oleic acid predominated in all cases. The relative content varied between 38 and 40% for many of the cultivars investigated. Among the polyunsaturated fatty acids, linoleic acid, which belongs to the ω-6 acid group, was conspicuous. Its relative content is 37-40%. For example, in peanuts grown in China [7] the level was 40.70%. This can be due not only to sorting, but also to weather, soil and agrotechnical conditions of plant cultivation.

Table 1 - Average concentration of fatty acids in peanuts imported from Uzbekistan and China

	Peanut Uzbekistan (n=3)	Peanut PRC (n=3)	Norm, %
Saturated fatty acids, %	17.148	18.931	
C14:0 Myristic	0.064	0.067	0.03
C15:0 pentadecanoic	0.032	0.028	
C16:0 palmitic	11.216	12.81	5.15
C17:0 margaric	0.063	0.050	
C18:0 stearic	2.67	3.896	1.10
C20:0 arachidic	0.060	0.064	
C21:0 geneucosan	0.023		
C23:0 tricosan	3.02	1.992	
Monounsaturated fatty acids, %	41.28	40.23	
C16:1 (cis-9) palmitoleic	0.047	0.037	0.01
C17:1 (cis-10) margaroleic	0.053	0.034	
C18:1 (cis-9) oleic	40.597	39.45	23.76
C20:1 (cis-11) eicosenoic	0.583	0.709	0.66
Polyunsaturated fatty acids, %	41.387	40.835	
C18:2 n6c linoleic	39.877	39.270	15.56
C18:3 n6 Y - linoleic	0.281	0.960	0
C20:3n3c (cis -11,14,17) eicosotriene	1.162	0.605	
C20:4 n6 arachidonic	0.067		

In the course of this study, the average concentration of SFA in walnuts from Uzbekistan was determined to be 11.23%, mainly with a high content (C16:0) of palmitic acid (6.68%). The fat present in the walnut from Uzbekistan is mainly composed of PUFAs, which is about 70% of the total fatty acids, and linoleic acid is the main polyunsaturated fatty acid. Monounsaturated fatty acids, which were about 20%, represent the second main fraction in walnut fat, almost exclusively due to the content of oleic acid.

The study found that the fat in Chinese walnuts contains mostly polyunsaturated fatty acids (67.418%), with the second most important type being monounsaturated fatty acids. Linoleic and Y-linolenic acids make up the majority of polyunsaturated fatty acids, with oleic acid (24%) being the most important monounsaturated fatty acid. The content of saturated fatty acids is an important part of the total fat composition, especially palmitic and stearic acids present in large amounts.

In each sample, the excess of the level of oleic acid was found to be two times higher, and the content of linoleic acid also exceeded the permissible norm by two times.

Table 2 - Average concentration of fatty acids in walnuts imported from Uzbekistan and China

	Walnut Uzbekistan (n=3)	Walnut PRC (n=3)	Norm
Saturated fatty acids, %	11.23	8.189	6.20
C14:0 Myristic	0.048	0.034	0.50
C15:0 pentadecanoic	0.019	0.027	
C16:0 palmitic	6,680	5.459	4.40
C17:0 margaric	0.041	0.046	
C18:0 stearic	4.277	2.508	1.30
C20:0 arachidic	0.166	0.115	
C21:0 geneucosan			
C23:0 tricosan			
Monounsaturated fatty acids, %	20.072	24.394	14.70
C16:1 (cis-9) palmitoleic	0.064	0.048	0.20
C17:1 (cis-10) margaroleic		0.046	
C18:1 (cis-9) oleic	19.980	24.142	11.0
C20:1 (cis-11) eicosenoic	0.128	0.155	1.10
Polyunsaturated fatty acids, %	68.698	67.418	40.40
C18:2 n6c linoleic	58.339	58.289	33.30
C18:3 n6 Y - linoleic	10.358	9.128	7.10
C20:3n3c (cis-11,14,17) eicosotriene			
C20:4 n6 arachidonic			

Studies of the fatty acid composition in cashew nuts gave the following results: where there is a high content of palmitic acid (9.195%), oleic (63.010%) and linoleic acid (16.976%). Cashews are considered a valuable product for their high content of monounsaturated fatty acids (63.401%). At the same time, all indicators exceeded the established norms twice.

Almonds are rich in monounsaturated fatty acids, the share of which is 70.590% of the total content, among which 70% is oleic acid, which exceeds the allowable content twice. Almond kernels contained 6.487% palmitic acid, 0.312% palmitoleic acid, 1.857% stearic acid, 70.158% oleic acid, and 20.986% linoleic acid.

Table 3 - Average concentration of fatty acids in cashews and almonds imported from Iran

	Cashew Iran (n=2)	Norm	Almond Iran (n=3)	Norm
Saturated fatty acids, %	19.527	9.16	8.401	3.80
C14:0 Myristic	0.039	0.35	0.025	0
C15:0 pentadecanoic	0.025			
C16:0 palmitic	9.195	4.35	6.487	3.08
C17:0 margaric	0.123		0.038	
C18:0 stearic	10.109	2.97	1.857	0.70
C20:0 arachidic				0.01
C21:0 geneucosan	-		-	
C23:0 tricosan	0.037			
Monounsaturated fatty acids, %	63.401	27.32	70,590	31.55
C16:1 (cis-9) palmitoleic	0.274	0.32	0.312	0.24
C17:1 (cis-10) margaroleic	0.032		0.075	
C18:1 (cis-9) oleic	63,010	26.81	70.158	31.29
C20:1(cis-11) eicosenoic	0.085	0.14	0.046	0.01
Polyunsaturated fatty acids, %	17,073	7.84	21.009	12.33
C18:2n6c linoleic	16.976	7.66	20.986	12.32
C18:3n6 Y-linoleic	0.097	0.16	0.023	
C20:3n3c (cis-11,14,17) eicosotriene	-		-	
C20:4n6 arachidonic	-		-	

Discussion

Walnuts are prized for their high oil content. As you know, it contains polyunsaturated fatty acids such as oleic acid, linoleic acid and linolenic acid.

Stearic acid and palmitic acid are types of saturated fatty acids. In fact, walnuts contain 40 to 500 times more omega-3 fatty acids than other nuts [18].

As a result of the study, the fatty acid composition of 17 walnut samples was analyzed and showed palmitic acid content (C16:0) in peanuts (China) was 12.8%, the highest among the samples evaluated in this study. Stearic acid content (C18:0) was highest in cashew nuts (Iran) 10.109%. In addition, the oleic acid content (C18:1) in almonds is 70.158%, the highest in walnuts, while walnuts have a low content of 20.1%. The highest linoleic acid content (C18:2) is 59.58% in nuts, the lowest is observed in cashew, where its density is only 16.976%.

Similar studies were carried out by foreign scientists, but depending on the variety and other factors, the results were as follows.

According to Cardassilaris, China's Shanxi province is experiencing a booming walnut culture, with particular emphasis on breeding varieties with a high oil content. Studies show that the oil content of different varieties from the same region varies from 59.4% to 71.5%, with an average of 65.9%. The variety "Xifu No. 1" stands out with the highest oil content - 71.5%. The average value of unsaturated fatty acids is about 92.4%, and the ratio of unsaturated to saturated acids is 7.6:1.

They also identified that among different varieties there were differences in the composition of fatty acids. The oleic acid-rich variety was "Jinglong No. 2" (40.5%), the linoleic acid-rich variety was "Liaoning No. 1" (66.5%), and the linolenic acid-rich variety was "Sifu No. 1" (13.5%). The N-6: N-3 ratio was closest to 4:1 in Zhonglin No. 1 (4.6:1) [19].

According to the research conducted by Alshannaq A. and colleagues, pistachios, similar to the majority of other nut varieties, possess a significant fat content, with existing studies suggesting an approximate value of 50%. However, some variations might lead to certain strains having notably elevated fat levels, with measurements reaching as high as 74.15%. Comparable to other nuts, pistachios exhibit a substantial abundance of unsaturated fatty acids, specifically monounsaturated fatty acids (MUFAs). This particular category is primarily dominated by oleic acid, along with the inclusion of palmitoleic acid. The following consequential segment, polyunsaturated fatty acids (PUFAs), is predominantly constituted by linoleic acid [20]. Further findings from X. Fan et al. established that saturated fatty acids (SFAs), a fraction consisting of minor fatty acids, predominantly comprises palmitic acid [21].

Conclusion

In conclusion, this study examining the fatty acid composition of imported nuts within the city markets of Astana has furnished significant insights into the variety and distinctions within the composition of diverse types and origins of nuts. The findings underscored the substantial presence of essential fatty acids in nuts, which hold a crucial function in facilitating plasma membrane integrity and promoting brain cell functionality.

The study also found that nut samples taken from the markets exceeded the fatty acid composition, which can be important information for consumers and producers regarding product quality and safety. Differences in fatty acid composition between different types of nuts and their origins allow for conscious choices when selecting nuts.

Overall, the results of the study highlight the importance of nuts in the diet, due to their rich composition of vegetable protein, unsaturated fats, fiber, vitamins and minerals. Further research in this area may be useful to increase knowledge about the nutritional properties of nuts and their impact on human health.

This study highlights the importance of quality food analysis and composition control for food safety and consumer awareness. This data can be valuable to regulators and manufacturers in developing quality standards and controlling the production and import of nuts.

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