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Beneficial effects of seeds and nuts

Efecto benéfico de las semillas y nueces

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ABSTRACT

Introduction: The consumption of seeds and nuts has beneficial effects on health because the saturated fatty acid content is low and nearly half of the total fat content is made up of unsaturated and monounsaturated fatty acids. **Objective:** To know the content of fatty acids in the different seed and nuts consumed in Mexico. **Method:** Study of the fatty acid composition of different seeds. **Results:** Interestingly, flaxseed and chia seed contained the highest concentration of omega-3 fatty acids, potential precursors of very long chain fatty acids, whereas peanut has the highest concentration of oleic acid. The highest rate ω3/ω6 was for flaxseed and chia seed. **Conclusions:** Seeds and nuts have a high content of monounsaturated and polyunsaturated fatty acids, which by including them in the diet in adequate portions can reduce inflammatory processes and thus the risk of cardiovascular diseases (CVD) and metabolic diseases. The ω3 and ω6 fatty acids are not synthesized in the human body, for this reason, it is important to consume these fatty acids in the diet.

Key words: seeds, nuts, omega-3, omega-6, fatty acids.

RESUMEN

Introducción: *el consumo de semillas y nueces tiene efectos benéficos para la salud debido a que el contenido de ácidos grasos saturados es bajo y casi la mitad del contenido total de grasa está constituido por ácidos grasos insaturados y monoinsaturados.* ***Objetivo:*** *conocer la porción de ácidos grasos en las diferentes semillas y nueces que se consumen en México.* ***Método:*** *estudiar la composición de ácidos grasos de diferentes semillas.* ***Resultados:*** *interesantemente, la linaza y la semilla de chía contenían la mayor concentración de ácidos grasos omega 3, potenciales precursores de los ácidos grasos de cadena muy larga, mientras que el cacahuate tuvo la mayor concentración de ácido oleico. El mayor índice ω3/ω6 correspondió a la linaza y a la semilla de chía.* ***Conclusiones:*** *las semillas y los frutos secos tienen un alto contenido en ácidos grasos monoinsaturados y poliinsaturados, que al incluirlos en la dieta en porciones adecuadas pueden reducir los procesos inflamatorios y, por lo tanto, el riesgo de enfermedades cardio vasculares (ECV) y de enfermedades metabólicas. Los ácidos grasos ω3 y ω6 no se sintetizan en el cuerpo humano, por esta razón, es importante consumir este tipo de ácidos grasos en la dieta.*

Palabras clave: *semillas, nueces, omega 3, omega 6, ácidos grasos.*

INTRODUCTION

The most common edible tree nuts are almonds, cashews, hazelnuts, macadamias, pecans, pistachio and walnuts. Peanuts (*Arachis hypogaea*) are botanically groundnuts or legumes (edible seeds enclosed in pods), and they belong to the same family as beans, lentils and peas, but they have a nutrient profile similar to tree nuts.[1]

Nuts, seeds and pulses are all nutrient dense foods and have been a regular constituent of the diet since pre-agricultural times. In Western countries, nuts are consumed as snacks, desserts or part of a meal, and are eaten whole (fresh or roasted), in spreads (peanut butter, almond paste), as oils or hidden in commercial products.[2] Recently, Western countries have increased the seeds and nuts consumption following the inclusion of this food group in many guidelines for healthy eating. In 2003, the Food and Drug Administration (FDA) issued a health claim for nuts because of the link between nut consumption and a reduced blood cholesterol and risk of cardiovascular disease (CVD). Thus, nuts are one of the natural plant foods richest in fat after vegetable oils.

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The consumption of fatty acid composition of nuts has beneficial effects on health because the saturated fatty acid (SFA) content is low (4-16 %) and nearly half of the total fat content is made up of unsaturated and monounsaturated fatty acids.[3]

A potential strategy to reduce CVD risk is the modification of the type of fat consumed. Partial replacement of saturated by unsaturated fats has very low rates of CVD.[4] Monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs) present in major proportion in olive and fish oils are highly effective in decreasing the oxidation of LDL-cholesterol and serum triglycerides (TG) levels.[5] Therefore, the US Dietary Guidelines, in recent years, has recommended to shift food choices from those high in SFA to those high in MUFAs and PUFAs.[4] Fish and vegetable oils represent an attractive target to low the intake of saturated fatty acids;[6] however, due to the cost of olive oil and fish, these products are not consumed regularly and hence it is important to look for other type of foods that provide an adequate amount of ω3 fatty acids. ***Table 1*** shows the main fatty acids in the diets.

Like so, the purpose of the present work is to evaluate the fatty acid profile of different fat sources such as seeds and nuts.

METHOD

Different types of seeds and nuts were studied including sesame seed, almond, poppy seed, anise, hazelnut, peanut, pinion, chia seed, fennel, flaxseed, mustard seed, cashew, pecan nut, pumpkin seed, pistachio, quinoa and sunflower seed. There was included one sample of salmon as a control of a food rich in very long chain fatty acids.

Seed, nuts and salmon lipids were extracted from approximately 250 mg of sample using chloroform-methanol, according to the method described by Folch, *et al*.[7] The organic layer was dried using liquid nitrogen and solubilized in isopropanol/Triton X-100 (10 %). The concentrations of fatty acids were measured and analyzed with gas chromatography (Agilent 6850 with flame ionization detector, USA) using a capillary column (INNOWax; J&W Scientific, USA). Concentrations were adjusted according to the amount of each sample used and plotted in percentage using Prism 7.0 (GraphPad Software Inc., CA, USA).

RESULTS

The fatty acids profile in the studied samples, revealed the presence of mainly MUFAs and PUFAs (up to 80 % of the total lipids), with a low concentration of SFA (lower than 20 %). Interestingly, mustard, sesame, poppy, quinoa, sunflower, chia and flaxseeds, contained approximately 65-85 % of PUFAs. The pistachio had approximately 57-59 % of PUFAs and the rest of the samples had less concentration of 50 %. In particular, the peanut showed the major concentration of MUFAs (99 %) of all samples and absence of PUFAs. In addition, fennel, hazelnut and almond, exhibited more concentration of MUFAs than PUFAs ***(Figure 1).***

Nevertheless, with this analysis it is not posible to distinguish the type of fatty acids. Because of this, the type of fatty acid in each sample was evaluated. In the present study, it was found that the most abundant long ω3 PUFA was linolenic acid (C18:3) and the most abundant ω6 was the linoleic acid (C18:2). Regardless of the seed type, C18:1 (oleic acid) was the predominant contributor of the MUFAs and C18:2 (linoleic acid) and C18:3 (linolenic) for the PUFAs, respectively. In particular, peanuts predominantly contained oleic acid with approximately 91.4 %. Yet, there are significant variations in linoleic acid and linolenic acid concentration in the seeds and nuts. Importantly, hazelnut, almond, cashew and pecan nut as well as fennel, anise, pumpkin seeds, sesame, poppy, and sunflower seeds have a high content of linoleic acid, between 32-77 %; while flaxseed, chia, mustard, quinoa seeds and pistachio showed a high content of both linoleic acid and linolenic acid.

These ω3 and ω6 fatty acids are not synthesized in the human body, for this reason, it is important to consume these acids in the diet. Linoleic acid in the body is the metabolic precursor of very long-chain PUFA, arachidonic acid (AA; C20:4), and linolenic acid (ALA)

Table 1. The most common omega-3 and omega-6 fatty acids.

Types	Abreviation	Common name	Structure	Type of fatty acid
Omega-3	ALA	α-Linolenic acid	C18:3	Long chain
	EPA	Eicosapentaenoic acid	C20:5	Very long chain
	DHA	Docosahexaenoic acid	C22:6	Very long chain
Omega-6	LA	Linoleic acid	C18:2	Long chain
	AA	Arachidonic acid	C20:4	Very long chain

is precursor of eicosapentaenoic acid (EPA; C20:5) and docosahexaenoic acid (DHA; C22:6). DHA and EPA are important fatty acids for brain function and can be obtained directly from the diet or synthesized in the body from linolenic acid (ALA).

Regarding the content of very long chain fatty acids, eicosapentaenoic acid (EPA; C20:5) and docosahexaenoic acid (DHA; C22:6), salmon was the food with the highest content of these very long chain fatty acids; nevertheless, several seeds, particularly pistachio and quinoa, presented low concentration of EPA and chia seed showed low concentration of DHA, as can be seen in ***Figure 2.***

Human beings evolved eating a diet with a ω6:ω3 of about 1:1. Modern Western diets exhibit ω6:ω3 ratios ranging between 15:1 to 17:1. Research has shown that increasing the ratio of ω3 to ω6 fatty acids in the diet, could consequently favor the production of EPA in the body. For this reason, we evaluated the ω3/ω6 and ω6/ω3 ratio to describe the best options.

The results of this study revealed that mustard seed displayed an adequate ratio of ω6/ω3 (1.19), whereas, pistachio and quinoa seed exhibited the highest ratio ω6/ω3 of 6.8 and 2.6, respectively. However, chia seed and flaxseed showed a ratio lower than 1 (0.2 and 0.3), indicating that these seeds have a healthy fatty acid profile ***(Figure 3A and B).*** These findings indicate that these two seeds can represent a beneficial option to reduce the risk of CVD and other metabolic diseases. For this reason, it is important to know the adequate intake of these seeds and nuts. ***Table 2*** present the recommended portions of these foods. A general recommendation on the intake of this type of seeds and nuts is 1 to 2 servings per day. However, the person's health status should always be considered.[8]

DISCUSSION

Several epidemiological studies have displayed that the development of CVD is associated with the type of dietary fat consumed.[9] Previous studies have reported that the consumption of MUFAs and PUFAs reduces the risk of developing CVD and other metabolic diseases; yet, these have been focused on studying fatty acids of the typical Mediterranean diet such as olive oil and deep-sea fish (salmon).[6] These types of foods are expensive to some populations because salmon is not native of Mexico, in consequence, some seeds and nuts could be a service of ω3 and ω6 fatty acids. Although the

Table 2. Recommended portions of nuts and seeds.

Source	Portion		ω3 (linolenic)	ω6 (linoleic)
Hazelnut	9 pieces	(13 g)	1.85 g	
Mustard	½ teaspoonful	(2 g)		0.114 g
Cashews	8 pieces	(13 g)		0.779 g
Pumpkin seed	1½ spoonful	(12 g)		0.697 g
Pecan Nut	3 pieces	(9 g)		1.64 g
Almond	10 pieces	(12 g)		3.03 g
Pistachio	18 pieces	(13 g)	.045 g	0.355 g
Sesame seed	4 teaspoonfuls	(10 g)		0.892 g
Chia seed	5 teaspoonfuls	(12 g)	1.81 g	0.677 g
Fennel	10 grams			0.792 g
Quinoa seed	20 grams		.251 g	0.685 g
Sunflower seed	4 teaspoonfuls	(12 g)		2.12 g
Flaxseed	1 spoonful	(7 g)	1.17 g	0.341 g
Anise	1 teaspoonful	(2 g)		0.299 g
Pinion	1 spoonful	(10 g)		1 g
Poppy seed	1 spoonful	(7 g)		0.615 g

*1-2 portions per day is recommended

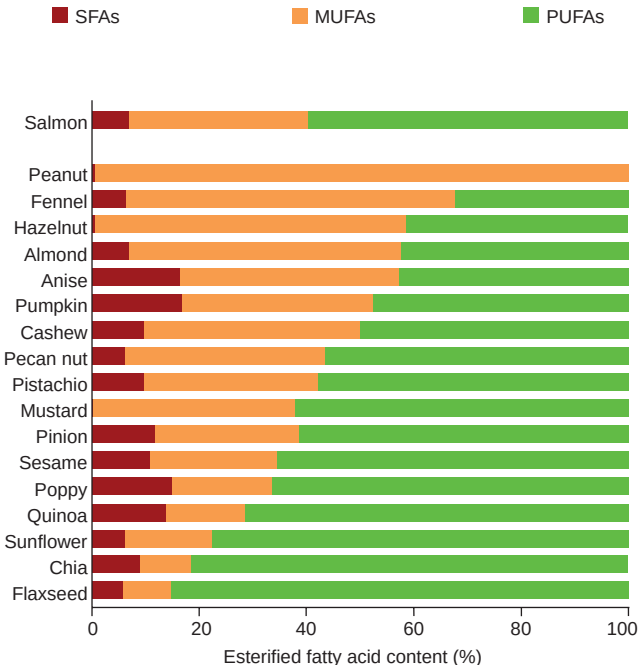

Figure 1. Fatty acid content in different seeds and nuts.

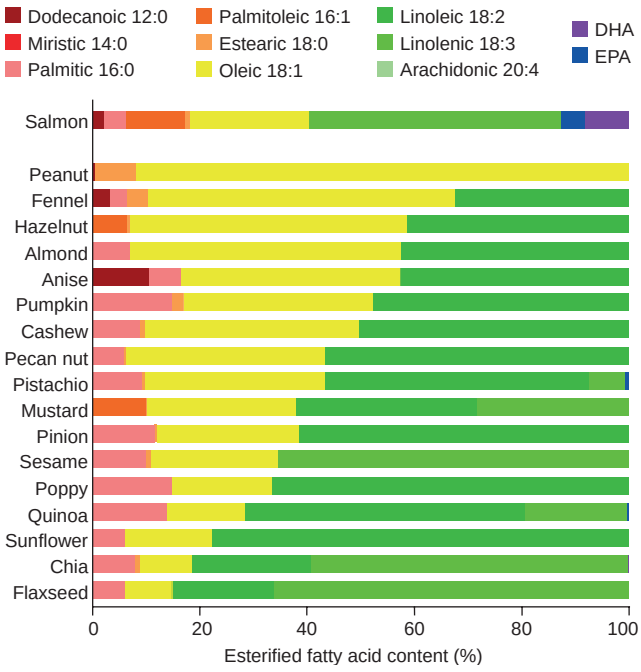

Figure 2. Fatty acid profile in different seeds and nuts.

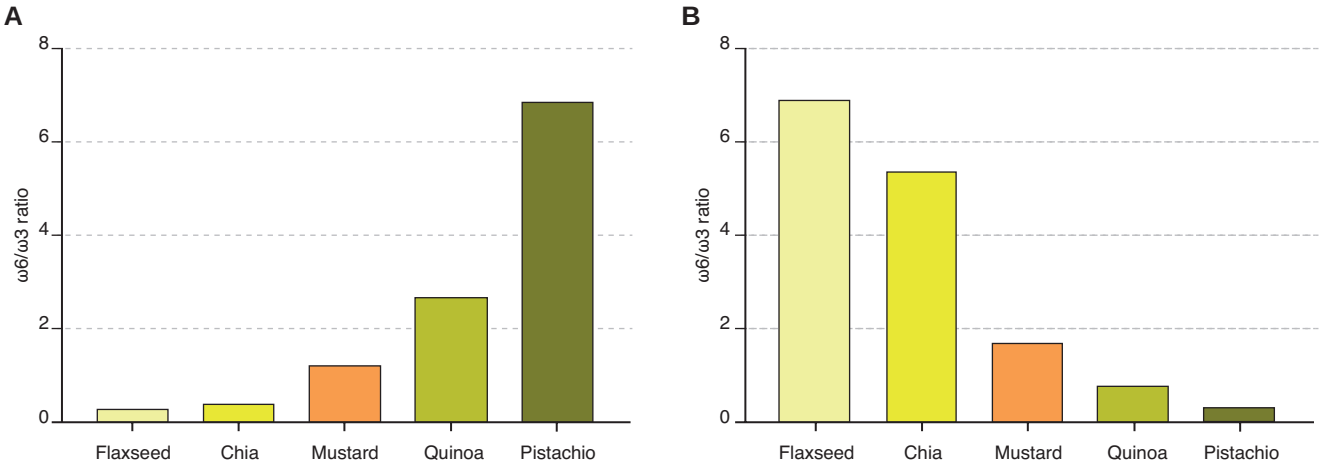

Figure 3A and B. Omega-6/omega-3 ratio in different seeds and nuts.

conversion rate from ω3 and ω6 fatty acids to form long chain fatty acids is low, this amount is enough to meet the brain DHA requirement. The brain DHA requirement is estimated to be only 2.4-3.8 mg/day in humans.[10] The very long chain fatty acids synthesis from ingested linolenic acid are typically < 1 % of the oral linolenic acid dose. There is also evidence that DHA synthesized from linolenic acid can meet brain DHA requirements, as animals fed linolenic acid have brain DHA concentrations similar to DHA-fed animals. Both, ω3 and ω6 fatty acids are considered essential fatty acids since they are not synthesized in the human body and are mostly acquired from the diet. These fatty acids are known to suppress the transcriptional factor involved in the regulation of lipogenic genes SREBP-1c (sterol regulatory element binding protein-1), downregulate the lipogenesis[11] and improve lipid metabolism. On the other hand, the results revealed that salmon had the highest concentration of EPA and DHA, whereas the seeds and nuts studied did not have adequate concentrations of these

long chain fatty acids; nevertheless, ω3 fatty acids are the precursors of EPA and DHA in the body. In fact, a complex series of desaturation and elongation reactions acting in concert transform linoleic and linolenic to their higher unsaturated fatty acids.[12] While the typical Western diet has a much greater ratio of ω6 PUFAs compared with ω3 PUFAs, research has shown that by increasing the ratio of ω3 to ω6 fatty acids in the diet, and consequently favoring the production of EPA in the body, a reduction in the incidence of many chronic diseases that involve inflammatory processes can be achieved.[13] In conclusion, seeds and nuts have a high content of MUFAs and PUFAs, which by including them in the diet in adequate portions can reduce inflammatory processes and thus the risk of CVD and metabolic diseases.

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