A CriticalReview of the Cardio-Protective Potential of Diets and Foods Rich in Soluble Fibre

Comment [S1]: Water-soluble dietary fibers and cardiovascular disease: A Comprehensive Review

Abstract

The purpose of this study was to critically review the cardio-protective potential of diets and foods rich in soluble fibre. Fibre which is found in plant-based food products like rye, wholegrain wheat, fruits, oats, nuts, legumes, and vegetables. Consuming fibre as well as wholegrain foods has been linked to various health benefits such as; a reduced risk of being overweight or obese, low risk of developing type 2 diabetes, cardiovascular diseases as well as a lesser risk of bowel cancer. The study critically reviewed concepts such as soluble fibre and Cardiovascular Diseases, other benefits of functional Foods in Hypercholesterolemia Family, Isoflavones**,** β –glucan, and **F**atty Acids. The study adopted the descriptive method in analysing issues relating to the cardio-protective potentials of diets. It recommended that dietary treatment should be accompanied by a professional nutritionist, for better grip and results to treatment. The dietary intervention alone is not enough to treat familial hypercholesterolemia, but it should always be the first measure implemented. The diet must be based on increasing the amount of mono- and polyunsaturated fatty acids, then reducing the consumption of saturated fatty acids, trans fat, and weight loss when required. Physical exercise should be encouraged mainly aerobic exercise, since exercise increases the concentration of HDL-C, reduced concentrations of triglycerides, and aids in weight loss. Stressing that patients with familial hypercholesterolemia should not start any physical activity without evaluation and accompanimentcardiological. In general, there is a need for more studies on familial hypercholesterolemia. Studies that relate to genetic disease and patient adherence to dietary treatment are unique for checking the concentrations of both total cholesterol, the LDL-C, and possibly to confirm the efficacy of isolated nutritional treatment, i.e. without the need for pharmacological treatment.

Keywords: Cardiovascular Disease, Dietary Fiber, Soluble Fibre, Cardio-Protective Diets, Hypercholesterolemia.

Introduction

Fiber is good for the health of one's digestive system. Even though this complex carbohydrate has long been associated with improved heart health, it is generally found in plant-based food products like rye, wholegrain wheat, fruits, oats, nuts, legumes, and vegetables. Consuming fibre as well as wholegrain foods has been linked to various health benefits such as; reduced risk of being overweight or obese (because foods high in fibre are filling and thus helpwith maintaining a healthy weight), low risk of developing type 2 diabetes, cardiovascular diseases as well as a lesser risk of bowel cancer. Furthermore, a high-fiber diet is a noble source of minerals, vitamins, and other healthy crucial nutrients needed by the body (Chen, Gislette, & Huang, 2010).

The various processes underlying this advantage are now starting to become clearer to researchers. Even preliminary research from the 1950s and 1960s indicated that fiber may play a significant role in preventing heart diseases. Since then, research from numerous large-scale long-term observational trials as well as short-term clinical trials have suggested that eating a diet high in fiber can lower the risk of heart attack and stroke by as much as 30%. The quantity and kind of fiber that makes a difference are currently being studied in further research.Three (3) kinds of fibre are found in different plant-based food sources: soluble (a kind that dissolves in water), insoluble fibre (one that does not dissolve in water), and resistant starch (a starch that escapes absorption by the small intestine but is fermented in the large intestine forming short-chained fatty acids) (Jahreis et al., 2016).

Studies byBazzano et al., (2011) in Australia showed that Australian women should eat about 25g of dietary fiber in a day and men should consume about 30g daily; although both men and women in Australia mostly consume less than this. Having an adequate fibre meal is not just about including unrefined wheat bran in cereals as it is believed by most people globally, it is thus crucial for fibre from various healthy plant-based sources to be included in daily meals and diets. (LEE & LIP, 2003).

Soluble fibre

Soluble fibre is found mainly in fruits and vegetables, and itforms a viscous consistency mixture in the stomach that provides a feeling of satiety by making food stay longer in the stomach, in

addition to correcting constipation by regulating the speed of Passage of the food bolus through the stomach, duodenum and intestine (Holscher, et al., 2015). The benefits of soluble fibres include:

Decreased appetite because they stay longer in the stomach;

a) It improves the bowel because it hydrates the faecal cake, being useful for diarrhoea and constipation;
b) Decrease pimples leaving skin more beautiful because it improves the elimination of toxins from the body;
c) Decrease in cholesterol and triglycerides because it decreases the absorption of fat from food (Chen, Gislette, & Huang, 2010).

Diets rich in fibre have been linked to decreased risk of mortality from cardiovascular disease, independent of energy intake, fat, or other factors affecting the diet. The intake of fibre helps reduce cholesterol concentrations in the blood since that reduces the process of fat absorption in the intestine. The fibers bind to bile acids, causing an increase in the degradation of cholesterol (Tester & Al□Ghazzewi, 2016). The much soluble fibre protects the body against various pathologies; recent research focus on the hypercholesterolemia effects of soluble fibre. The action of soluble fibre on cholesterol control is related to physicochemical properties present in water retention, apparent solubility, binding capacity, and degradation (AACE, 2012). The daily fibre intake recommendations are 20 - 30 grams/day (Table 2).

The soluble fibre in contact with water forms a viscous gel in the stomach and therefore naturally decreases the appetite and also ferments in the intestine regulating pH, thuspositively selecting the type of intestinal bacteria regulating bowel functioning by increasing faecal volume (Jahreis, et al., 2016). The content and degree of viscosity of the fibre depend on the degree of maturation of the vegetable, and the more mature its quantity of certain soluble fibre types such as cellulose and lignin, the more it reduces the content of another type of fibre. Soluble fibre, pectin. The amount of total dietary fibre consumed daily should be approximately 25g, according to the World Health Organization (WHO), and the ideal amount of soluble fibre that should be ingested should be 6 grams. Fibre supplements can be used when it is not possible to consume the amount of fibre needed per day and achieve the same benefits. These fibres can be found in capsules and powder, which can be diluted in water, tea, milk, or natural fruit juice.

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As a guideline, we suggest the restriction corresponding to stage 1 of the diet National Cholesterol Education Program (Table 1). The consumption of fibres(Soluble) represented by pectin (fruits) and gums (legumes, oats, and barley) acts in delaying gastric emptying and increasing the time of intestinal transit, making it slower in glucose uptake, retards starch hydrolysis, and reduces CT and LDL-c, therefore consumption should be stimulated (Chen, Gislette, & Huang, 2010). The diet consists mainly of white meat skin and fish), red meat apparent fat, all vegetables, fruits, vegetable oils (except coconut and palm oil), cream margarine, skim milk, and its derivatives. If the guidelines are unsatisfactory after six months of diet, Cholesterol and fat are adopted as per Phase 2 of Table 1.

Soluble fibre and Cardiovascular Diseases

A recent study showed that orange juice intake by healthy individuals on a diet rich in fats and carbohydrates prevents oxidative stress and inflammatory, which can lead to insulin resistance (Wu, et al., 2015). Other studies have consistently shown that chronic consumption of orange juice reduces the levels of Serum levels of total and LDL-C cholesterol and improvement of endothelial function, leading to the risk of atherosclerosis (Drozdowski, Reimer, Temelli, Bell, Vasanthan, & Thomson, 2010) and hypertension (Surampudi, et al., 2016). Others have shown that drinking about 500 ml/day increases Vitamin C in plasma and reduces the concentrations of markers of oxidative stress (Holscher et al., 2015).

In addition, it was suggested that the intake of fruit juice enhances lipid profile and reduces the risk of cardiovascular diseases (Drozdowski et al., 2010) and can suppress species reactive oxygen and inflammatory processes (Surampudi et al., 2016). Secondly, orange juice has an anti-inflammatory effect, being able to decrease the generation of reactive oxygen species, and this effect is probably attributed to flavonoids: naringin and hesperidin (Rossi, et al., 2015). Clinical studies have shown that citrus flavonoids act in synergy with Vitamin C, potentializing its antioxidant effect on blood lipoproteins (Salehi-Abargouei, et al., 2013). Cardoso, et al., (2015) pointed out that the regular consumption of orange juice increased vitamin C intake in the diet and was associated with a lower incidence of hypertension and obesity in men, suggesting that the juice, or its components, helps in the prevention of hypertension.

Ötles and Ozgoz (2014) reported that the consumption of orange juice associated with aerobic training in overweight women decreased the risk of Cardiovascular disease, reduced LDL-C levels, and increased HDL-C levels. Mente, et al., (2009) demonstrated that the consumption of red orange juice increases concentrations of antioxidants. The lifestyle and facilities of the contemporary world have influenced dietary habits, favoring a caloric diet with Carbohydrates or lipids, known as "Westernized" or "fast food" (Gonciulea & Sellmeyer, 2016). The amount of overweight and obese individuals has been increasing significantly in the world, as a consequence of endogenous factors (heredity, congenital factors, Psychogenic, neurological, and endocrine) and exogenous (diet, sedentary lifestyle, etc.). Most of the cases are related to environmental factors, mainly the lack of physical activity and inadequate eating habits (Liu, et al., 2016). With this, there is an increase in mortality rates and interference in the quality of life of individuals, which is based on the results obtained in the literature. Harris and Kris-Etherton (2010) asserted that it is becoming a matter of concern for world public health, since it may Increase overall mortality.

The caloric intake above the energy recommendations is a phenomenon of modern societies, and has, in the long term, negative consequences such as the incidence of chronic degenerative diseases. In rodents, the experiments have verified the effects of hyperlipidemic intake to reproduce humans and clarify this approach to food, and its intercurrences at the biochemical and physiological level (Harkin, et al., 2015). Based on the evidence described here, the juice has beneficial effects on lipid profile, maintenance of body composition and protection against the deleterious effects of a hyperlipidic diet. Besides being an important source of vitamins and fibres, fruits and citrus juices have recently been recognized as containing secondary metabolites including antioxidants such as ascorbic acid, phenolic compounds, flavonoids, limonoids that are important for nutrition.

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Benefits of Functional Foods in Hypercholesterolemia Family

The new concept of food promoters of good health, and functional foods are related to the reduction action of risk of diseases or Control the same; for example on high cholesterol - hypercholesterolemia (Ho, et al., 2016). It is a challenge for nutrition professionals to introduce the individual not only to traditional nutrients, established over the years in the study of nutrition, but also extend them to the concept of preventive nutrients (Gonciulea & Sellmeyer, 2016). In

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this regard, other food components, are not only the traditional part of the feed. Compounds that exist in foods and nutrients are not classic but have functional properties beneficial to health. Importantly, no food alone can be used as formula magic to solve and prevent health problems. To obtain the desired effect functional foods should be part of healthy eating habits and food balanced, as well as adjusted to the needs of each individual (Ho et al., 2016). Meet some important functional foods in controlling hypercholesterolemia family, half of action, major food sources, and recommended daily intake.

Isoflavones

Studies have shown the protective effects of soy on cardiovascular disease and its consequent hypercholesterolemia, that due to lipid abnormalities, decreased LDL-C and lipoprotein Apo B and increased HDL-C, vascular effects, progression of plaque Atherosclerosis (Liu, et al., 2016). A possible mechanism of asoy-basedcholesterol-lowering agent is the connection of isoflavones to oestrogen receptors within cells similarly estradiol, which influences the metabolism of cholesterol and lipoproteins.

Other studies show that the replacement of an animal protein diet for protein soybean is capable of reducing LDL-C cholesterol by 20 to 30% in cases of hypercholesterolemia severe. Ameta-analysis of 38 studies, published in 1995 by Anderson et al., presented that the ingestion of 47 grams of soy protein per day, containing about 100 mg isoflavone, provided significant reductions in total cholesterol, LDL-C, and triglycerides and also promoted a small increase in HDL-C.

One explanation for this reduction can be increased excretion of bile salts faeces as a main way of eliminating cholesterol or increasing the metabolism of cholesterol to compensate for the increased elimination of bile salts. In addition, soy protein intake decreases insulin vs. glucagon, hormones that are involved in cholesterol metabolism (Mente, de Koning, Shannon, & Anand, 2009). One phospholipid found in high concentration in soybean (2 to 2.5%), lecithin is an excellent adjuvant for the good preservation of the heart arteries, it helps to reduce blood cholesterol and triglyceride (Harkin et al., 2015). The main sources of soy and replacement options are soybean oil, soy cheese (Tofu), soy grit, soy sauce (soy sauce), soybean paste (miso), soy flour, soy milk Roasted soybean tempeh (Harkin et al., 2015). In this way, regular

consumption of foods based on soy. It can be an important ally to control hypercholesterolemia. The soybean varieties containing low isoflavone content will not be as efficient in lowering cholesterol, the greater amount of isoflavones are found in natural food. The isoflavones of soy protein indeed need to work, study show that without the soy protein, the cholesterol-lowering effect is not so significant (Ho, et al., 2016). The daily intake recommendation would be 25 grams/day (Table 2).

β -glucan

The action of β-glucan has been widely studied as a hypercholesterolemia agent. Oat bran is the richest in soluble fibre and greater capacity to lower blood cholesterol. It is from the separation process of the oat grain and part of the group of cereals (Salehi-Abargouei et al, 2013). Studies with oat bran demonstrate strong action in the reduction of serum cholesterol, probably by your gum content, where it was observed to decrease total cholesterol and LDL-C. This effect can be attributed to the absorption of bile acids, after their de-conjugation by intestinal bacteria, and excreted in the faeces or by short-chain fatty acids produced by Bacterial degradation of colon fibres, which also inhibit the synthesis of cholesterol Hepatic (Holscher et al., 2015). Oats inclusion in reducing total cholesterol and LDL-C has been documented in scientific papers since the late (Salehi-Abargouei et al, 2013). Despite these changes they are small compared to drug therapy, the reduction of 1% cholesterol You can reduce the risk of CHD by 2-4%.

Anderson et al (1995) studied eight hypercholesterolemia men to determine the effects of supplementation with oat bran on concentrations of lipids plasma. Individuals who received the diet supplemented with bran for 10 days, showed an average 13% reduction in the concentrations of serum cholesterol and 14% in LDL-C concentrations (Holscher et al., 2015). The main sources of oats and replacement options are oat flakes, flour oatmeal, oat bran, cooked white beans, broccoli, mango, and wheat to quibe (Salehi-Abargouei et al, 2013). In 1997, the US Department of Agriculture (FDA), after rigorous evaluation studies Clinical and epidemiological recognized 3 grams daily intake efficiency beta-glucan in the reduction of CHD risk. From this, the FDA has authorized the use of advertisements on product packaging and oat derivatives such as health benefits. The recommended daily intake of B-glucan is 20 - 30 grams/day (Table 2).

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Fatty Acids, Unsaturated

Fatty Acid Monounsaturated

The family of fatty acid (FA) Omega-9 belongs to the group of fatty acids Monounsaturated. Oleic acid is known as the omega-9, is an acid monounsaturated fatty, which has long been considered essential by properties beneficial in reducing the oxidation of LDL-C (Jahreis et al., 2016). Its main sources are olive oil and canola, olive, avocado, and oleaginous (walnuts, chestnuts, peanuts, almonds) (Wu et al., 2015). The oil extracted from olives contains oleic acid, but depending on the processing for obtaining oil, including the use of solvents and alkalinisation or to reduce acidity, the beneficial properties can be compromised (Wu et al., 2015). The extra virgin olive oil is the one that is not extracted by solvents, and is obtained by cold compression of the olive, which it does not alter the nature of the seed (Wu et al., 2015).

Monounsaturated fatty acids are characterized by containing only an installation in the hydrocarbon chain. The main representative of the AGMIs is oleic acid, classified as AGI of series ω-9, being the most often found in nature. The main sources of oleic acid are olive and canola oils, though these can be synthesized by all mammals. Erucic acid is also obtained from canola oil but is eliminated in the process of extracting the oil due to its undesirable taste and for producing myopathies in humans (Wu et al., 2015). In addition to olive oil, the oils of sunflower, soybean, safflower, corn, and peanuts are also sources of oleic acid (IAS, 2013). The studies reported the influence of AGMIs on comparing nutrients. When we compared the intake of a diet rich in AGMIs with a hyperlipidemic diet it was possible to observe that the former results in lower values of triglycerides and total cholesterol and slight increases in HDL values (Wu et al., 2015).

Cardoso, et al., (2015) carried out a systematic review of studies epidemiological studies to assess the effects of the Mediterranean diet, known currently has cardio-protective effects. This food pattern is characterized by a high consumption of fatty acids AGMIs, using olives and olive oil associated with the daily intake of fruits, vegetables, cereals, weekly fish, small amounts of dairy products, and red meat. The results of this analysis concluded that this food pattern is associated with discrete increases in HDL levels (1.17mg / dL) and reductions of 6.14mg / dL of triglycerides (Bazzano et al., 2011). Although there are some inconsistencies, the influence of the Mediterranean diet on arterial hypertension evidenced that the ingestion of AGMIs is inversely

proportional to blood pressure values, in patients. However, this response is only observed ingestion of olive oil, rich in oleic acid, and not in Western diets, where the sources of AGMIs are some types of meat. This reduction in Blood pressure, as measured by olive oil, is believed to be mediated by the change in the formation of fatty acids in cell membranes (Gonciulea & Sellmeyer, 2016). The studies also indicate, in the context of the Mediterranean diet, that the intake of AGMIs is related to lower risks of developing arterial disease coronary artery disease, and death (Liu et al., 2016). The beneficial effects of olive oil depend on the use of extra virgin oil, especially the polyphenol content and its main effects

1. Potent inhibitor-free radicals;
2. Oxidation inhibitors of LDL-C;
3. Platelet aggregation inhibitors;
4. Antithrombotic (Liu et al., 2016).

Monounsaturated FA helps in reducing hypercholesterolemia without lower HDL-C and should be encouraged, wherever possible, to replace the saturated fat the unsaturated (Gonciulea & Sellmeyer, 2016). The recommendation would be 20% of the total calories of the diet (Table 2).

Fatty Acid Polyunsaturated

The families of fatty acids (FA) essential omega-3 and omega-6 belong to the group of polyunsaturated fatty acids (Harkin et al., 2015). The fatty acid type is based on the first position double bond concerning the terminal methyl (Tester & Al□Ghazzewi, 2016). The essential fatty acid omega-3, called α-linolenic acid is the precursor of fatty acids long-chain eicosapentaenoic (EPA) and docosahexaenoic acid (DHA), which also can be obtained through the diet. This process of formation of EPA and DHA is through enzyme action (Tester & Al□Ghazzewi, 2016). The sources of omega-3 fatty acids are divided into two groups: animals and plants. Animal sources are rich in EPA and DHA and comprise mainly fatty fish and its oils, so are called marine sources. The vegetable sources have higher Omega-3 quantities and mainly include oilseeds and vegetable oils (Ho et al, 2016). The source of omega-3 AG, most studied is marine (fish oil).

The main representatives of the AGPIs are the AGIs of the series ω-6 and ω-3. The AGI of the ω-6 series is found in nuts, seeds, and vegetable oils, with corn, sunflower, and soybean (Ros Tapsell &Sabaté, 2010). Linoleic acid is an example of this series and will, in the course of

metabolization, Arachidonic (AA - 20: 4) also of the series ω-6 (Tester & Al□Ghazzewi, 2016). The results of studies that evaluated the relationship between acid intake Ω-6 fatty acids and the risk of heart disease, especially coronary heart disease Linoleic and arachidonic acid) showed controversial results. Despite being precursors of pro-inflammatory mediators that promote vasoconstriction and action and increase LDL levels when compared to AGS, They are still able to reduce the risk of coronary heart disease (LOTTENBERG, 2009). However, when compared to the ingestion of ω-6 PUFAs with ω-3 PUFAs, the Risk of coronary disease is higher (Mente et al., 2009).

The AGI of the ω-3 series is found in fish, mainly savelha, Salmon, tuna, and anchovies (Harris & Kris-Etherton, 2010). A-linolenic acid (18: 3) is the main Representative of this series and is found in plants and marine animals. After your Eicosapentaenoic acids (EPA - 20: 5) and Docosahexaenoic acid (DHA - 22: 6), which can also be found in large Concentrations in deep and cold water fish oils, Mackerel, sardines, salmon, and trout (Tokede et al., 2011). Linoleic (18: 2 ω-6) and α-linolenic (18: 3 ω-3) acids are essential because their cells cannot insert a double bond and these fatty acids must be obtained by feeding (Bazzano et al., 2011). Contrary to the controversial results observed in the studies with the Fatty acids ω-6, human and animal studies with fatty acids Ω-3 showed that they can improve cardiac hemodynamic factors Such as blood pressure, diastolic filling of the left ventricle, and cardiac and endothelial function. In addition, Antiarrhythmic, anti-inflammatory, and anti-atherosclerotic drugs, in addition to the Reduction of triglycerides

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A source alternative to oil would be the consumption of the fish itself, the main sources and options for replacements are sardines, tuna, trout, cod, mackerel, and salmon. However, as encouraging fish consumption contrasts with the financial issue, plant sources of Omega-3 fatty acids become more feasible, and are easily used as seeds, oilseeds, and vegetable oils (Jahreis et al., 2016). It should be taken into account that the use of seed and linseed flour does not have the taste, of fish oil and has the advantage of being mixed with other foods such as milk, yogurts, juices, and fruits, it is less Caloric (Tokede et al., 2011). Flaxseed, used in the East since ancient times, is one of the foods rich in omega-3, it stands out for its preventive effect, cardio-protective and prevents clots to reduce the concentrations of total cholesterol and LDL-C and increase HDL concentrations (Mente et al., 2009).

There are two types of flaxseed: brown and golden. Studies show that there is no difference in the composition of the two types, as well as the antioxidant activity and the amount of nutrients. The benefits are enhanced when the seed is crushed, since its shell is resistant to the action of gastric juice and does not suffer tract action reducing the absorption of nutrients (Tester & Al□Ghazzewi, 2016). Recommendations for omega-3 consumption are shown in Tables 1 & 2.

Table 1: Dietary Guidelines for Treatment of Familial Hypercholesterolemia

Nutrients "Traditional"	**Recommended Intake**	
	Phase 1	**Phase 2**
Total fat	Less than 30% of total calories	
Saturated Fatty Acids	Less than 10%	Less than 7%
Fatty acids polyunsaturated	Up to 10% of total calories	
Monounsaturated Fatty Acids	10% to 15% of total	
calories carbohydrates	50% to 60% of total	
calories proteins	1g / 1kg of ideal weight	
Cholesterol	≤ 300 mg / day	≤ 200 mg / day
Total calories	To achieve or maintain the desired weight	

Table 2: Functional Foods and Recommended Daily Intake for aid in Treatment of Familial Hypercholesterolemia.

Functional Food	**Recommended Daily Intake**
Isoflavones group Soy protein and Derivatives	25 g / day
Group Fibers - betaglucans Soluble and insoluble fibres Oat bran Fruits and Vegetables	20 - 30 g / day
Group Fatty Acids, Unsaturated C. monounsaturated Extra virgin olive oil Canola and Oilseed oil	20% of the total calories in the diet

C. polyunsaturated fatty 1. Animal Origin Fish (sardines, tuna, trout, cod) Fish oil 2. Vegetable Origin Seed / linseed meal Linseed oil	 2 to 3 times / week 2 to 3 capsules/day 15 grams / day ~ 1 tablespoon 2 to 3 capsules / day
Phytosterols	1.5 to 3.0 grams / day

Phytosterols

Phytosterols are sterol compounds derived from vegetable oils and have great structural similarity with cholesterol. The most studied phytosterols are sitosterol and campesterol, which have an unsaturation in their structure, similar to cholesterol. These work as a supplement to diet safely, they are well tolerated and useful in the treatment of non-pharmacological hypercholesterolemia, seeking rapid reduction of LDL-C (Drozdowski et al., 2010). The review of studies evaluating the effectiveness of margarine supplemented with phytosterols identified an average 14% decrease in LDL-C, with a daily dose greater than or equal to 2 g / day in individuals aged between 50 and 59 years. Recently, other clinical studies were published, allowing greater knowledge about the action of hypercholesterolemia phytosterols (Jahreis et al., 2016). An increased hepatic cholesterol production can occur when there is a higher consumption of phytosterols, such as an adaptation of the body to recover the concentrations of previous serum. However, this answer depends on the individual genetic predisposition, Sample subjects with familial hypercholesterolemia. Studies showed that there greater reduction of LDL-C in homozygous group for apolipoprotein (Apo B), supplemented with sitostanol (Drozdowski et al., 2010).

Generally, phytosterols are effective in hypercholesterolemia and may be used both in isolation and in combination with other hypercholesterolemia agents. Existing evidence is mainly food products, to which these Compounds were added. The adverse effect attributed to the

supplementation of phytosterols refers to the slight decrease in absorption of fat-soluble vitamins, namely A and E, which can be offset by increased consumption of fruits and vegetables (Jahreis et al., 2016). Consumption of phytosterols should be between 1.5 to 3.0 grams/day (Table 2).

Discussion/Conclusion

It is imperative to include fibres and functional foods that reduce the absorption of intestinal cholesterol, phytosterols-enrichedportions of margarine, oat bran, and flour or flaxseed, extra virgin olive oil. These dietary measures provide a reduction in LDL-cholesterol concentration of 10 to 15%. Dietary treatment should be accompanied by a professional nutritionist, for better grip and results to treatment (Chen, Gislette, & Huang, 2010). The dietary intervention alone is not enough to treat familial hypercholesterolemia, but it should always be the first measure implemented. The diet must be based on increasing the amount of mono- and polyunsaturated fatty acids, then reducing the consumption of saturated fatty acids, trans fat, and weight loss when required. Physical exercise should be encouraged mainly aerobic exercise, since exercise increases the concentration of HDL-C, reduced concentrations of triglycerides, and aids in weight loss. Stressing that patients with familial hypercholesterolemia should not start any physical activity without evaluation and accompaniment cardio logical (Surampudi et al., 2016). In general, there is a need for more studies on familial hypercholesterolemia. Studies that relate to genetic disease and patient adherence to dietary treatment are unique for checking the concentrations of both total cholesterol, the LDL-C, and possibly to confirm the efficacy of isolated nutritional treatment, i.e. without the need for pharmacological treatment.

References

AACE (2012). American association for clinical endocrinologists guidelines for the manangement of dyslipidaemia and prevention of atherosclerosis. Accessed online: www.aace.com/files/lipid-guidelines.pdf

Bazzano LA, Thompson AM, Tees MT, Nguyen CH, Winham DM. (2011). Non-soy legume consumption lowers cholesterol levels: a meta-analysis of randomized controlled trials. Nutr. Metab. Cardiovasc. Dis. 21, 94–103

Cardoso, S.M., Pereira, O.R., Seca, A.M., Pinto, D.C. and Silva, A., (2015). Seaweeds as preventive agents for cardiovascular diseases: From nutrients to functional foods. *Marine drugs*, *13*(11), pp.6838-6865.

Chen, J., Gislette, T. and Huang, X.F., 2010. The role of molecular weight and viscosity of oat β-glucan in hypocholesterolemic effect. *The American journal of clinical nutrition*, *92*(6), pp.1538-1538.

Drozdowski, L.A., Reimer, R.A., Temelli, F., Bell, R.C., Vasanthan, T. and Thomson, A.B., 2010. β-Glucan extracts inhibit the in vitro intestinal uptake of long-chain fatty acids and cholesterol and down-regulate genes involved in lipogenesis and lipid transport in rats. *The Journal of nutritional biochemistry*, *21*(8), pp.695-701.

Gonciulea, A.R. and Sellmeyer, D.E., 2016. The effect of dietary protein source on serum lipids: Secondary data analysis from a randomized clinical trial. *Journal of Clinical Lipidology*.

Harkin, N., Berger, J., Guo, Y., Schwartzbard, A., & Gianos, E. (2015). DIET AND THE PREVENTION OF CARDIOVASCULAR DISEASE: PHYSICIANS'KNOWLEDGE, ATTITUDES, AND PRACTICES. *Journal of the American College of Cardiology*, *65*(10), A1447.

Harris KA, Kris-Etherton PM. (2010). Effects of whole grains on coronary heart disease risk. Curr. Atheroscler. Rep. 12, 368–376

Ho, H. V. T., Sievenpiper, J. L., Zurbau, A., Mejia, S. B., Jovanovski, E., Au-Yeung, F., ... & Vuksan, V. (2016). A systematic review and meta-analysis of randomized controlled trials of the effect of barley β-glucan on LDL-C, non-HDL-C and apoB for cardiovascular disease risk reductioni-iv. *European journal of clinical nutrition*.

Holscher, H.D., Caporaso, J.G., Hooda, S., Brulc, J.M., Fahey, G.C. and Swanson, K.S., 2015. Fiber supplementation influences phylogenetic structure and functional capacity of the

human intestinal microbiome: follow-up of a randomized controlled trial. *The American journal of clinical nutrition*, *101*(1), pp.55-64.

IAS (2013). An international atherosclerosis society position paper: Global recommendations for the management of dyslipidemia.

Jahreis, G., Brese, M., Leiterer, M., Schäfer, U., & Böhm, V. (2016). Legume flours: Nutritionally important sources of protein and dietary fiber. *ErnahrungsUmschau*, *63*(02), 36-42.

Liu, C., Lin, X.L., Wan, Z., Zou, Y., Cheng, F.F. and Yang, X.Q., 2016. The physicochemical properties, in vitro binding capacities and in vivo hypocholesterolemic activity of soluble dietary fiber extracted from soy hulls. *Food & Function*, *7*(12), pp.4830-4840.

Mente A, de Koning L, Shannon HS, Anand SS. (2009). A systematic review of the evidence supporting a causal link between dietary factors and coronary heart disease. Arch. Intern. Med. 169, 659–669

Ötles, S., & Ozgoz, S. (2014). Health effects of dietary fiber. *ActaScientiarumPolonorumTechnologiaAlimentaria*, *13*(2), 191-202.

Ros E, Tapsell LC, and Sabaté J. (2010). Nuts and berries for heart health. Curr. Atheroscler. Rep. 12, 397–406

Rossi, M., Johnson, D.W., Xu, H., Carrero, J.J., Pascoe, E., French, C. and Campbell, K.L., (2015). Dietary protein-fiber ratio associates with circulating levels of indoxylsulfate and p-cresylsulfate in chronic kidney disease patients. *Nutrition, Metabolism and Cardiovascular Diseases*, *25*(9), pp.860-865.

Salehi-Abargouei, A., Maghsoudi, Z., Shirani, F., &Azadbakht, L. (2013). Effects of Dietary Approaches to Stop Hypertension (DASH)-style diet on fatal or nonfatal cardiovascular diseases—incidence: a systematic review and meta-analysis on observational prospective studies. *Nutrition*, *29*(4), 611-618.

Surampudi, P., Enkhmaa, B., Anuurad, E., & Berglund, L. (2016). Lipid Lowering with Soluble Dietary Fiber. *Current atherosclerosis reports*, *18*(12), 75.

Tester, R.F. and Al□Ghazzewi, F.H., 2016. Beneficial health characteristics of native and hydrolysed konjac (Amorphophallus konjac) glucomannan. *Journal of the Science of Food and Agriculture*.

Tokede OA, Gaziano JM, Djoussé L. (2011). Effects of cocoa products/dark chocolate on serum lipids: a meta-analysis. Eur. J. Clin. Nutr. 65, 879–886

Whitehead, A., Beck, E.J., Tosh, S. and Wolever, T.M., 2014. Cholesterol-lowering effects of oat β-glucan: a meta-analysis of randomized controlled trials. *The American journal of clinical nutrition*, *100*(6), pp.1413-1421.

Wu, Y., Qian, Y., Pan, Y., Li, P., Yang, J., Ye, X., & Xu, G. (2015). Association between dietary fiber intake and risk of coronary heart disease: A meta-analysis. *Clinical Nutrition*, *34*(4), 603-611.

Comment [S9]: All the reference should be according to guidelines.