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Cardio-Protective Effect of Chickpea

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Abstract

Chickpeas, an annual plant from the Fabaceae family, are abundant in protein, carbohydrates, fibre, essential minerals, and vitamins. It is grown all over the world and is considered an inexpensive and nutrient-dense pulse. Protein quality is better than in other pulses. Chickpea consumption is linked to better health outcomes. Chickpea protein peptides are becoming increasingly well recognised, and they can be formed by acid, alkaline, or enzymatic degradation. Enzymatic hydrolysis is considered safe, and various enzymes are used to synthesise peptides. These peptides have several bioactive properties, including angiotensin 1-converting enzyme inhibition, digestive sickness, hypocholesterolemia, cardiovascular disease, antioxidant activity, type 2 diabetes, anti-inflammatory, antibacterial, or anticarcinogenic activity. Diabetic rats reported significantly greater blood lipid profile values, including total cholesterol, triglycerides, LDL-C, and VLDL-C, despite a decrease in high-density lipoprotein. This might be due to increased free fatty acid release from insulin-resistant lipid cells, which are the primary cause of the fat changes associated with diabetic dyslipidemia. The higher lipid profile in the positive control group might be attributable to oxidative stress, which increases lipid peroxidation and reduces antioxidant defense capability.

Keywords: *Chickpea, cardio, antioxidant.*

Introduction

According to studies, the natural active components in various plants offer different benefits in

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treating hyperlipidemia and preventing cardiovascular disease. Furthermore, various studies have focused on the hypolipidemic benefits of phytochemicals, which are multi-component, multi-targeted, and low in toxicity. Plants are natural sources of medicine, and their roots, stems, leaves, and seeds contain polysaccharides, flavonoids, saponins, phytosterols, fatty acids, phenols, polypeptides, and other tiny molecular components used in cardiovascular disease treatments. Several in vitro and animal studies have shown that ingesting these bioactive phytochemicals decreases hypertension, low-density lipoprotein oxidation, lipid peroxidation, total plasma antioxidant capacity, or dyslipidemia. (Islam et al; 2021).

Years of study on hypolipidemic phytochemicals has revealed the structural properties of their essential components, as well as the mechanism of action. For example, it has been postulated that plants contain many physiologically active phytochemicals that can act on a variety of targets in complex disease networks. Furthermore, several phytochemicals interact synergistically with each target to disrupt disease development and, finally, give therapeutic advantages. Interestingly, it is uncertain if individual components provide the true advantages, making phytochemical synergy study a prominent topic of interest. (Gao et al; 2019).

1. Chickpea (Cicer arietinum L)

Pulses are referred to as "meat for poor men," and due to their high protein content, they have a unique place among the world's poorest countries. Pulses are leguminous plants which can grow in any type of soil. They may assist in using nitrogen in the soil, improve soil fertility, and contribute significantly to sustainability in both the economy and the environment. Chickpeas, the most basic legume pulse crop, were cultivated around 7500 years ago in the Middle East. (Olvera et al; 2024).

Chickpea (Cicer arietinum L.), frequently referred to as Garbanzo beans, is considered a high-quality protein source with considerable nutritional value for humans. Chickpeas (CP) are available in two varieties: "Desi" and "Kabuli". The Desi type accounts for 80-85% of the total CP area, with Africa and Asia being the main producing locations, whilst the Kabuli variety is grown mostly in Europe, North Africa, West Asia, & North America. India leads in chickpea production, with over 6 million tonnes produced each year, followed by Pakistan. Other nations that produce chickpeas include Southern Europe, North Africa, Australia, & America. (Zhao et al; 2021).

Turkey, Iran, Pakistan, & India jointly account for 70% of world chickpea production. Chickpeas are the world's third most significant pulse crop, behind field peas and dried beans. Pakistan, Bangladesh, and India were the CP's largest importers in 2020, while Russia, Australia, and Canada were its major exporters. In impoverished countries, CP is the main basket food. It is a popular seed snack, nevertheless the preparation method differs depending on area and ethnicity. According to the WHO, CP is high in non-starch polysaccharides but low in calories. Lentils, beans, and CP are abundant in minerals, vitamins, and fiber, and are considered fundamental components of a healthy diet for everyone. CP has a high nutritional value and might be used as a food that serves a purpose to treat several conditions. (Jukanti et al; 2012).

Furthermore, multiple studies have shown that the CP has the most protein and dietary fiber of any pulse. Fiber-rich dietary intake is recommended for a range of conditions. Fiber is vital for weight loss & is particularly recommended for people who are obese. Furthermore, dietary fiber may help reduce the risk of stroke, type 2 diabetes, coronary heart disease, gastrointestinal problems, and hypertension. Previous studies have also found that bioactive compounds generated from CP exhibit an antihypertensive effect. Proteins generated from CP provide a well-balanced source of critical amino acids with high bioavailability. (Bhagyawant et al; 2019).

Chickpea protein hydrolysate has several biological effects, including decreased antigenic activity and suppression of angiotensin I-converting enzyme (ACE) (8). Organic compounds like isoflavones and polyphenols can help reduce the risk of hypertension, inflammation, diabetes, and metabolic syndrome. Chickpeas are a popular pulse crop that has been widely used as a meal in industrialized countries. Chickpeas are nourishing for humans and play an important role in the treatment of many diseases. There is limited information available on the nutritional components, in addition to the extraction & composition of bioactive peptides. (Summo et al; 2019).

2. Cardiovascular diseases

Cardiovascular illnesses are a major global issue, accounting for 17.1 million deaths per year and an estimated 20 million by 2020. In Pakistan, heart illnesses account for around 25% of all fatalities. Despite efforts by medical and pharmaceutical researchers to battle heart disease, the number of cardiac patients is growing. Synthetic cardioprotective medications are costly and have adverse effects. Medicinal herbs rich in polyphenols have free radical scavenging capacity, which may lower the risk of heart disease due to the inverse association between polyphenol consumption and cardiovascular disease. Free radicals are reactive species produced in the body from both endogenous and external sources, causing cell damage, necrosis, and apoptosis. Antioxidants such as vitamins C and E, as well as plant polyphenols, can be helpful instruments for lowering oxidative stress & cardiovascular disease as possible therapeutic agents. (Olvera et al; 2024).

A complete clinical history and physical exam are used to diagnose CVD, which includes variables such as obesity, angina, poor exercise tolerance, orthopnea, syncope, & claudication. Patients should be sent for a more in-depth history and physical examination, as well as any required ancillary diagnostic testing. Primary preventive initiatives should target persons who have risk factors and address modifiable risk factors. Starting at the age of 20, patients should be included in discussions about CVD risk factors & cholesterol measurements. (Goff et al; 2014).

Calculators that utilize LDL and HDL cholesterol levels, as well as other risk variables, provide a 10- or 30-year CVD score to assess if further medications, such as statins and aspirin, are required for primary prevention. However, these calculators have limitations, such as analyzing patients with diabetes and familial hypercholesterolemia as eliminating those above the age of 79 from the cohorts. An individualized strategy is advocated, considering the risks and advantages of supplementary medicines, as well as life expectancy. (Greenland et al; 2010).

Preventative interventions like good eating habits, avoiding obesity, and leading an active lifestyle are critical for all patients, particularly those with non-modifiable risk factors that include a family history of early CHD or postmenopause. While inflammatory indicators and risk assessment approaches such as coronary artery calcification score (CAC) are still under investigation, they remain promising tools for recognising persons with subclinical coronary artery disease at risk for CVD. (Budoff et al; 2006).

International health policies primarily advocate for healthy diets, particularly plant-based & Mediterranean diets, owing to their various components and bioactive phytochemicals such as flavonoids. Flavonoids, a broad collection of metabolites with varied chemical structures, have been intensively studied for their ability to reduce the risk of coronary artery disease (CVD). They offer cardiovascular benefits such as antihypertensive, vasorelaxant, anti-atherosclerotic, & antithrombotic properties. Flavonoids are classified as flavones, 3-hydroxyflavones (flavonols), & flavans. Flavonolignans, phenols of heterogeneous origin, were initially isolated in milk thistle and have been investigated for their hepatoprotective and cardioprotective properties. Recent research has demonstrated the cardioprotective properties of silymarin

extract & its main ingredient, silibinin. (Tomou et al; 2023).

2.1 Hyperlipidemia & Total Cholesterol (TC)

The word hyperlipidemia refers to a rise in the concentration of one or more serum or plasma lipids, often cholesterol and triglycerides, whereas dyslipidemia refers to an increase or decrease in the concentration of one or more plasma and serum lipids. Type 2 diabetics have a much higher risk of coronary coronary artery disease than comparable dyslipidemia nondiabetics. Low HDL or HDL2 cholesterol, high VLDL cholesterol, along with elevated total & VLDL triglycerides are strong risk factors for coronary heart disease events in people with type 2 diabetes mellitus. (Hill et al; 2024).

According to the Strong Heart Study, LDL cholesterol is an independent predictor of cardiovascular disease in diabetic individuals, along with age, albuminuria, fibrinogen, HDL cholesterol (inverse predictor), & % body fat. Atherogenic dyslipidaemia (diabetic dyslipidaemia) is defined by three lipoprotein abnormalities: higher very-low-density lipoproteins (VLDL), tiny LDL particles, and low HDL cholesterol (the lipid triad). Regardless of the high and widespread prevalence of dyslipidaemia among people both with and without diabetes, only 2.2% of adults without diabetes and 32% of diabetic patients received treatment with diet, exercise, or drugs to lower lipid levels, and less than one-third of patients with established coronary artery disease received this type of therapy. (Mohamed et al; 2004).

Blood total cholesterol levels were reduced. This led to a reduction in very-low-density lipoprotein (VLDL) cholesterol. Chickpeas reduced LDL and HDL cholesterol while boosting apolipoprotein A4 levels or lecithin-cholesterol acyltransferase activity. APOA1 levels remained unchanged in the treated groups. Total & esterified cholesterol levels in the liver were two times lower in both treatment groups than in the control group. Chickpea increased the amounts of triacylglycerols and phospholipids but decreased the levels of unesterified cholesterol. However, only chickpea treatment reduced serum, VLDL, & HDL malondialdehyde levels without increasing glutathione peroxidase activity. (Yahia et al; 2004).

In the context of adequate glycogen supplies, the rise in lipid profile may be attributable to increased passage of free fatty acids via hepatocytes, which promotes triglyceride formation. Serum triglycerides, total cholesterol, and very low-density lipoprotein cholesterol (VLDL-C) levels all rose. Reduce serum high density lipoprotein cholesterol (HDL-C) levels and raise serum low density lipoprotein cholesterol levels (LDL-C). (Cox and García; 1990).

2.2 Triglycerides (TG) (mg/dl)

Individuals with diabetes were 2-4 times more likely to have a stroke or die from heart disease than those without it. Triglyceride levels are often elevated in type 2 diabetic patients. The risk of cardiovascular disease linked with mild hypertriglyceridemia is becoming more widely discussed. Although low-density lipoprotein (LDL) is a well-established risk factor in diabetes, so statins remain first-line therapy for heart attack reduction, it has become obvious that "residual risk" persists for cardiovascular disease, despite attainment of target LDL-C levels. (Alexopoulos; 2019).

High triglyceride levels can cause artery hardening (atherosclerosis), increasing the risk of a stroke, heart attack, or heart disease. They may be associated with metabolic syndrome, which includes excess abdominal fat, high blood pressure, excessive blood sugar, & abnormal cholesterol levels. The best macronutrient(s) to replace dietary saturated fat to lower the risk of cardiovascular disease is still debated. Chickpeas are high in dietary fiber and polyunsaturated fats. (Liang et al; 2022)

Pittaway et al. (2007) found that adding chickpeas to a wheat-based diet with equal fibre

content improved blood lipids, glucose tolerance, satiety, and bowel function. A third, lower-fibre wheat diet revealed further information about dietary fibre amount, intestinal function, and satiation. Pittaway et al. (2007) found that the chickpea diet reduced blood TC by 0.25 mmol/L ($p < 0.01$) and LDL-C by 0.20 mmol/L ($p = 0.02$) compared to wheat. During the chickpea diet, there was an unanticipated large rise in PUFA and a matching drop in MUFA intake, which was statistically adjusted for, but the effect on serum lipids was still there.

2.3 HDL Cholesterol (HDL-C)

The chickpea-supplemented diet significantly reduced blood total cholesterol and low-density lipoprotein cholesterol levels ($p < 0.01$) by 3.9 and 4.6%, respectively, as compared to the wheat-supplemented diet. The chickpea-supplemented diet resulted in decreased protein (0.9% of energy, $p = 0.01$) or monounsaturated fat (3.3% of total fat, $p < 0.001$) intakes, as well as considerably greater carbohydrate consumption (1.7% of energy, $p < 0.001$) compared to the wheat-supplemented diet. Multivariate analysis revealed that the variations in serum lipids were mostly related to minor differences in polyunsaturated fatty acids or dietary fibre levels between the two intervention meals. (Pittaway et al; 2006).

Epidemiological studies consistently show that low HDL cholesterol levels relate to an increased risk of type 2 diabetes. Thus, raising plasma HDL cholesterol has been proposed as a unique treatment strategy for lowering the risk of type 2 diabetes. Diabetic dyslipidemia is characterized by low HDL cholesterol and high triglycerides, with high triglycerides being proved to be a marker of type 2 diabetes rather than a cause. It is unclear if low levels of HDL cholesterol have a direct effect on the likelihood of developing type 2 diabetes. (Haase et al; 2015).

Experimental research shows that HDL cholesterol levels may contribute to the pathogenesis of type 2 diabetes by directly influencing plasma glucose levels. HDL cholesterol promotes pancreatic β-cell insulin production and regulates glucose absorption in skeletal muscle in several experimental and human contexts. However, genetic findings from people and mice connecting genes that influence HDL cholesterol levels to glycemic management and the risk of developing type 2 diabetes are inconsistent. Furthermore, genome-wide association studies have not shown links between these HDL cholesterol-related genes and the incidence of type 2 diabetes. (Fazio and Linton; 2013). According to Shafi and Tabassum (2019), the increase in serum HDL-C after administration of Eriobotrya japonica extract could be due to the presence of glycosides, alkaloids, and flavonoids.

2.4 LDL Cholesterol (LDL-C) & VLDL Cholesterol (VLDL -C)

Managing the significant risk of cardiovascular morbidity and death in diabetes patients presents a challenge for practicing doctors. To reduce the burden of cardiovascular disease in diabetes, increased LDL cholesterol should be assessed and treated. Statins are the preferred treatment, and rigorous statin medication may be required to accomplish the current target of <100 mg/dl or the optional goal of <70 mg/dl indicated for high-risk patients, as well as address other aspects of diabetic dyslipidemia. Along with rigorous glucose and blood pressure management, extensive LDL cholesterol therapy in diabetic patients can have a significant impact on long-term health outcomes (Richard; 2008). Siebel et al; 2013 discovered that eating chickpeas reduced overall cholesterol levels by up to nearly 4%, while low-density lipoproteins (LDL) decreased by at least 3%. Chickpeas weren't shown to have a substantial effect on high-density lipoprotein (HDL) or triglyceride levels.

Defects in insulin function and hyperglycemia may result in alterations in plasma lipoproteins in diabetic patients. On the other hand, especially in the case of type 2 diabetes, underlying obesity/insulin-resistant metabolic disarray which lies at the base of this kind of diabetes may

lead to lipid abnormalities independent of hyperglycemia. (Ira; 2001).

Diabetes mellitus offers a much better picture of the link between diabetes, insulin insufficiency, and lipid/lipoprotein metabolism. Hypertriglyceridemia and low HDL are typical complications of poorly managed diabetes and ketoacidosis. Substitution of insulin in these people may remedy these anomalies, and well-controlled diabetics may have higher HDL and lower than usual triglyceride levels. (Haffner et al; 2000).

Hypertriglyceridemia and low plasma HDL cholesterol are two prevalent lipoprotein abnormalities in type 2 diabetes, formerly known as noninsulin-dependent diabetes mellitus. In addition, low density lipoprotein (LDL) is transformed to smaller, maybe more atherogenic, lipoproteins called small dense LDL. In contrast to type 1 diabetes, this phenotype is seldom totally rectified with glycemic management. Furthermore, this dyslipidemia is commonly identified in prediabetics, or people with insulin resistance but normal plasma glucose levels. This lipid anomaly is thus connected with aberrant insulin action rather than hyperglycemia. In line of this notion, several thiazoladinediones increase insulin effects on peripheral tissues & lead to a higher improvement in lipid profiles as found with other glucose-lowering drugs. (Ira; 2001, Ginsberg et al; 1996).

2.5 Hypertension

Hypertension, meaning high blood pressure, is the leading cause of heart disease. Other conditions, such as heart failure or renal disease, stroke, and myocardial infarction, are closely related to hypertension. The ailments described above claim the lives of almost 9.4 million people. The dipeptidyl carboxypeptidase angiotensin I-converting enzyme (EC 3.4.15.1) controls cardiovascular function and blood pressure. It transforms the inert decapeptide angiotensin I into the powerful vasoconstricting octapeptide angiotensin II by removing dipeptide from the C-terminus, which can elevate blood pressure. Although ACE inhibitors help to prevent hypertension, it is uncertain whether strategy is better: blocking the receptors which bind angiotensin II & signal vasoconstriction or directly inhibiting ACE. (Messerli et al; 2018).

Many blood pressure drugs suppress the angiotensin-I converting enzyme. Synthetic medications (captopril, enalapril, and lisinopril) are useful for short-term use, but they have serious side effects. To overcome the limitations of synthetic drugs, scientists are exploring for natural inhibitors for angiotensin I-converting enzymes. In this context, peptides that block the angiotensin I-converting enzyme gain favour. (Hicks et al; 2018).

Several peptides contained in food sources, such as beans, can inhibit the angiotensin I-converting enzyme. Chickpea protein and hydrolysate showed 50% ACE activity, and the techniques used in the study were well-standardized. Papain-produced chickpea hydrolysate had the highest efficacy to block the ACE enzyme (IC50=0.010 μg/mL). Chickpea flour hydrolysate has ACE inhibitory properties. Previous research discovered four ACE inhibitory peptides using enzymatic hydrolysate of chickpea protein having low molecular weight (<1 kDa) and inhibitory activity (IC50 = 0.1 mg/mL). Two of the peptides exhibited high activity. Peptides with more amino acid residues offer the highest activity. (Pedroche et al; 2002). In Barbana et al, 2010 found that protein hydrolysate from chickpea desi variation with molecular weight < 4 kDa has high ACE activity, with an IC50 of 140 ± 1 μg/mL.

Conclusion

Endocarditis, rheumatic heart disease, & conduction system abnormalities are all illnesses that can harm the cardiovascular system, which includes the heart and blood vessels.

Cardiovascular sickness, sometimes known as heart disease, consists of four separate entities: coronary artery disease (CAD), cerebrovascular disease, peripheral artery disease (PAD), and aortic atherosclerosis. Angina is caused by CAD, which reduces myocardial perfusion and can lead to myocardial infarction, MI, or heart failure. Cerebrovascular illness is associated with strokes and transient ischemic episodes. PAD generally affects the limbs and can result in claudication. Aortic atherosclerosis is associated with thoracic and abdominal aneurysms.

Chickpeas, an annual plant from the Fabaceae family, are high in protein, carbs, fibre, minerals, and vitamins. It is grown all over the world and is regarded as an affordable and nutrient-dense pulse. Protein quality is higher than in other pulses. Chickpea intake is connected to improved health outcomes. Chickpea protein peptides are becoming more widely recognised, and they can be produced by acid, alkaline, or enzymatic degradation. Enzymatic hydrolysis is deemed safe, and several enzymes are utilised to create peptides. These peptides exhibit a variety of bioactive qualities, including angiotensin 1-converting enzyme inhibition, digestive disorders, hypocholesterolemia, cardiovascular disease, antioxidant activity, type 2 diabetes, anti-inflammatory, antibacterial, & anticarcinogenic action.

Diabetic rats had significantly higher blood lipid profile values, namely total cholesterol, triglycerides, LDL-C, and VLDL-C, despite a reduction in high-density lipoprotein. This might be related to increased free fatty acid generation by insulin-resistant lipid cells, which is the major source of the fat alterations associated with diabetes dyslipidemia. The increased lipid profile in the group with a positive control could be attributed to oxidative stress, which causes lipid peroxidation and reduces antioxidant defense capabilities.

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