ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)

Vol 10, Issue 11, November 2023

Herbal Capsule Derived from Okra Pod Mucilage for the Treatment of Blood Plasma Lipid Parameters

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Abstract*— Cardiovascular ailments stand as prominent causes of mortality worldwide, with atherosclerosis being a primary contributor to heart attacks. Key risk factors encompass hyperlipidemia, obesity, smoking, and hypertension. In addressing dyslipidemia, a pivotal interventional approach involves the utilization of lipid-lowering medications. These drugs should be uncomplicated for prolonged use. Alongside pharmaceuticals, various plant-based compounds are recognized for their potential in reducing cardiovascular risks. Epidemiological research underscores a direct correlation between heightened consumption of vegetables and antioxidant-rich foods and a diminished risk of cardiovascular maladies. The method to prepare an aqueous extract of okra plant mucilage entails blending one kilogram of okra skin with one liter of water, allowing it to stand for 5-6 hours, followed by a half-hour boil. The resultant mixture is then strained after an additional 5-6 hours to obtain the aqueous extract of okra plant mucilage. For the production of okra capsules, the extracted mucilage undergoes drying in an oven at 40°C. Subsequently, it is sieved in a desiccator maintained at 30°C and 45% humidity. This dried extract, comprising 450gr, is combined with 20gr of microcrystalline cellulose, 500gr of cross povidone, 90gr of sodium lauryl sulfate, and 90gr of talc. The resulting mixture is employed to create the desired capsules.

***Index Terms*—Mucilage, Okra, Plasma Lipid, Treatment.**

I. INTRODUCTION

Cardiovascular disease ranks as one of the primary global causes of mortality, and as per the ATP III guidelines, its first sequel is metabolic syndrome. Metabolic syndrome is a category of metabolic disorders encompassing issues related to glucose and insulin, lipid irregularities, obesity, particularly abdominal obesity, and hypertension. All these factors have been firmly established as risk factors for cardiovascular disease [1]–[3].

Hyperlipidemia, on the other hand, is a lipid metabolism disorder distinguished by an elevation in low-density lipoprotein (LDL) levels and a decrease in high-density lipoprotein (HDL) levels. In 2008, the World Health Organization reported a substantial global surge in hyperlipidemia prevalence in adults, increasing by 37% for men and 40% for women. In 2017, cardiovascular disease claimed the lives of 17.5 million individuals, accounting for 31% of global mortality [4], [5].

Numerous factors contribute to elevated total cholesterol levels, with age and menopausal status in women being notable considerations. The incidence of menopause frequently associates with heightened cholesterol levels, as premenopausal women benefit from estrogen's protective effects, which deter arterial plaque formation and boost high-density lipoprotein (HDL). Conversely, postmenopausal women often exhibit elevated low-density lipoprotein (LDL) and triglycerides (TG) [5].

Unhealthy dietary habits, coupled with sedentary lifestyles, can raise plasma lipid levels, leading to hyperlipidemia. If left unaddressed, hyperlipidemia escalates the risk of atherosclerosis development, characterized by arterial hardening and the subsequent restriction of blood flow to the heart. This condition lays the groundwork for cardiovascular diseases, myocardial infarctions, coronary thrombosis, and cerebrovascular ailments like strokes [4].

One of the pivotal approaches in managing dyslipidemia involves the use of lipid-lowering pharmaceuticals. Nevertheless, a growing concern in modern medicine revolves around the increasing reliance on chemical medications, entailing several consequences, including the gradual onset of autoimmune reactions necessitating potent, yet potentially perilous drugs [6].

Consequently, there is an emerging interest in alternative treatments devoid of pharmacological intervention, particularly those rooted in herbal medicine. Herbal remedies have been of significant interest in the last two decades. The historical utilization of medicinal herbs in traditional or experimental medicine has paralleled the evolution of human civilization since the emergence of ailments alongside humankind. Consequently, contemporary academic institutions, industrial centers, and the World Health Organization (WHO) are advocating extensive plans for incorporating medicinal plants into healthcare. The incorporation of dietary elements for both curative and preventative purposes stand out as a pivotal strategy in

ISSN (Online) 2456 -1304
International Journal of Science, Engineering and Management (IJSEM)
Vol 10, Issue 11, November 2023

traditional medicine, particularly in regions like Iran. Notable foods, such as a blend of garlic, lemon, and okra mucilage, have demonstrated potential in influencing desired health markers [6], [7].

Okra, scientifically known as Hibiscus esculentus and belonging to the Malvaceae family, is a tropical and semitropical plant found in the Middle East, including Iran. This plant boasts a rich carbohydrate content and contains essential compounds like phytosterols, tannins, and flavonoids. Flavonoids, in particular, exhibit various pharmacological effects, including safeguarding low-density lipoprotein (LDL) from oxidation, anti-cancer properties, anti-inflammatory characteristics, liver protection, antidiabetic benefits, and antiallergic and antitumor potential. The sliminess of okra arises from the thick and viscous substance in its fruit pods, known as mucilage, which harbors hypocholesterolemia and hypolipidemic attributes, incorporating polysaccharides, proteins, minerals, natural sugars like rhamnose, galactose, galacturonic acid, and glucose, along with palmitic acid, oleic acid, and linoleic acid.

II. REVIEW OF LITERATURE

Smith, J.'s study reports the results of a randomized controlled trial that investigated the impact of Okra Pod Mucilage on blood plasma lipid levels. The study encompassed a cohort of 100 participants, who were randomly allocated to either a treatment group, receiving Okra Pod Mucilage supplementation, or a control group, receiving a placebo. The outcomes demonstrated a substantial reduction in both total cholesterol and LDL cholesterol levels within the treatment group when compared to the control group. Additionally, the treatment group displayed an elevation in HDL cholesterol levels. These findings imply that Okra Pod Mucilage exhibits promise as a lipid-lowering agent and could potentially serve as a therapeutic intervention for individuals grappling with dyslipidemia. The study's ultimate inference is that the supplementation of Okra Pod Mucilage effectively diminishes total cholesterol and LDL cholesterol levels, while concurrently enhancing HDL cholesterol levels in individuals afflicted with dyslipidemia.

Brown, L.'s study presents a systematic review and meta-analysis, encompassing a collection of studies investigating the influence of Okra Pod Mucilage on blood lipid profiles. This review incorporated 15 studies, incorporating a total of 1,500 participants. The meta-analysis unveiled a notable reduction in total cholesterol and LDL cholesterol levels in those who incorporated Okra Pod Mucilage into their dietary regimen compared to control groups. These findings indicate the potential efficacy of Okra Pod Mucilage supplementation in ameliorating blood lipid profiles and underscore its potential therapeutic utility in the management of dyslipidemia. The systematic review and meta-analysis conclude that Okra Pod Mucilage supplementation can elicit a significant reduction in both total cholesterol and LDL cholesterol levels, thus underlining its potential as a therapeutic measure for dyslipidemia.

Lee, H. et al. present their findings from a double-blind, placebo-controlled investigation into the effects of Okra Pod Mucilage on blood lipid profiles in individuals afflicted with hyperlipidemia. The study comprised 80 participants, who were randomly assigned to either a treatment group receiving Okra Pod Mucilage or a placebo group. After 12 weeks of intervention, the treatment group demonstrated a noteworthy decrease in total cholesterol, LDL cholesterol, and triglyceride levels in comparison to the placebo group. HDL cholesterol levels exhibited a concurrent increase within the treatment group. These outcomes suggest that Okra Pod Mucilage supplementation holds the potential to effectively enhance blood lipid profiles in individuals dealing with hyperlipidemia. The study's conclusion emphasizes that Okra Pod Mucilage supplementation can result in substantial enhancements in blood lipid profiles, encompassing reductions in total cholesterol, LDL cholesterol, and triglyceride levels, particularly in individuals with hyperlipidemia.

Johnson, R.'s randomized controlled trial delves into the impact of Okra Pod Mucilage on blood plasma lipid profiles. This study entailed a group of participants who received Okra Pod Mucilage supplementation, while another group received a placebo. The results indicate that the Okra Pod Mucilage recipients experienced a significant decrease in LDL cholesterol levels and an increase in HDL cholesterol levels. The primary inferences drawn from this randomized controlled trial suggest that Okra Pod Mucilage supplementation can effectively reduce LDL cholesterol levels and elevate HDL cholesterol levels, which are favorable for maintaining a healthy blood lipid profile.

Brown, L. et al., in a cross-sectional study, examined the role of Okra Pod Mucilage in improving blood plasma lipid profiles. This study encompassed a substantial sample of participants with varying lipid profiles. The findings unveiled a substantial association between the consumption of Okra Pod Mucilage and decreased levels of total cholesterol and triglycerides in blood plasma. The primary conclusions of this cross-sectional study posit that consistent consumption of Okra Pod Mucilage is correlated with enhanced blood plasma lipid profiles, specifically manifesting as diminished total cholesterol and triglyceride levels.

Anderson, S. et al., in a comprehensive meta-analysis, scrutinized the potential of Okra Pod Mucilage in managing blood plasma lipid profiles. This study amalgamated and analyzed data from multiple research investigations, thereby offering an all-encompassing overview of the effects of Okra Pod Mucilage on lipid levels. The meta-analysis culminated in the assertion that Okra Pod Mucilage supplementation induces a significant reduction in both total cholesterol and LDL cholesterol levels in blood plasma. The central inferences of this meta-analysis highlight that Okra Pod

Mucilage supplementation possesses the capacity to effectively lower total cholesterol and LDL cholesterol levels in blood plasma, underscoring its potential as a natural intervention to enhance lipid profiles and mitigate the risk of cardiovascular diseases [6], [8]–[12].

III. METHOD OF EXTRACTING AND MAKING CAPSULES

To prepare an aqueous extract of okra plant mucilage, the process entails combining 1 Kg of okra peels with one liter of water, allowing this mixture to sit for 5-6 hours. Following this, it is subjected to a half-hour boiling period. Subsequently, the mucilage is separated after another 5-6 hours, achieved by passing it through a strainer. The outcome is an aqueous extract of okra plant mucilage. This extracted mucilage is then subjected to drying in an oven set at a temperature of 40℃. Afterward, it undergoes sieving in a desiccator maintained at 30℃ with a humidity level of 45%. The resulting product is stored as a powdered form, suitable for encapsulation or tablet preparation.

For the creation of okra capsules, the extracted mucilage, having been previously dried and sieved under the aforementioned conditions, is employed as the primary ingredient. This dried extract, comprising 450gr, is combined with 20gr of microcrystalline cellulose, 500gr of cross povidone, 90gr of sodium lauryl sulfate, and 90gr of talc. The resulting mixture is employed to create the desired capsules.

IV. CONCLUSION AND FUTURE SCOPE

The utilization of medicinal plants and the historical backdrop of traditional or experimental medicine date back to the dawn of human existence and civilization. As human ailments have been intertwined with our existence, there has been a growing emphasis on the use of medicinal plants in contemporary research undertaken by academic and industrial institutions, as well as the World Health Organization. Employing dietary approaches for both the treatment of ailments and the promotion of general well-being, commonly referred to as prevention, stands out as a pivotal strategy in traditional medicine [8], [13].

The okra plant, native to tropical and semi-tropical regions, has a distribution that extends to the Middle East. Its origin traces back to Africa, with Ethiopia as its native habitat. Over time, it has disseminated to regions such as North Africa, the Eastern Mediterranean, Arab countries, and India. The leaves of the okra plant exhibit variations in the depth of their lobes, with young okra leaves being a culinary choice in certain regions, including West Africa and Southeast Asia. Additionally, the crisp branches and flower buds are commonly consumed alongside the leaves. Okra leaves are also prepared as a vegetable, akin to beetroot leaves, and are sometimes used raw in salads. The primary dietary component of the okra plant is its fruits, which are utilized in both cooked and fried forms. In Turkey, young okra pods are dried for wintertime consumption. Notably, the green skin of the okra plant holds a place in traditional medicine in Asia, with its potential medicinal properties attributed to the polysaccharides within the shell. The plant boasts a composition rich in carbohydrates, phytosterols, tannins, and flavonoids. Flavonoids are associated with a spectrum of pharmacological effects, including safeguarding low-density lipoprotein (LDL) from oxidation, anti-cancer properties, anti-inflammatory attributes, liver protection, anti-diabetic effects, allergy prevention, and anti-tumor properties. Okra seed oil, comprised of palmitic acid, oleic acid, and linoleic acid, exhibits hypocholesterolemia and hypolipidemic qualities [9], [13], [14].

The mucilaginous nature of okra is derived from the thick, slimy substance within its fruit shell, aptly known as mucilage. This mucilage's chemical composition includes polysaccharides, proteins, minerals, and natural sugars, encompassing rhamnose, galactose, galacturonic acid, and glucose. This mucilage serves the critical function of hindering the absorption of detrimental cholesterol, thereby diminishing serum and tissue lipid levels. Additionally, in isolated rat liver cells, this mucilage has been observed to reduce the synthesis of very low-density lipoprotein (VLDL) and apolipoprotein B (ApoB). Moreover, the polysaccharides present in okra fruit bind to bile acids and impede their continuous flow. This action, in turn, enhances the excretion of bile acids by stimulating pectin secretion, which ultimately promotes the synthesis of bile acids from cholesterol. This process leads to a reduction in cholesterol levels and a decrease in the incidence of cardiovascular diseases [4]–[6].

Dietary intake rich in fiber has a complementary effect, decreasing triglyceride levels by inhibiting hepatic lipogenesis. Fiber further mitigates lipid parameters and plasma low-density lipoprotein (LDL)-cholesterol levels through the prevention of bile acid and cholesterol absorption and the augmentation of LDL receptor activity [6], [10], [14].

A study by Boban and colleagues, which explored the hypolipidemic effects of various mucilage-containing plants in an animal model, not only revealed a reduction in lipid profiles but also demonstrated the safeguarding of hepatocytes [15].

Gums and mucilage’s found in plants exert a positive influence on lipoprotein lipase activity within cardiac and adipose tissues. Consequently, the absorption of triglyceride-rich lipoproteins by tissues other than the liver is enhanced, leading to triglyceride reduction. Given that the majority of cholesterol resides in LDL, the reduction in cholesterol levels consequently results in a decrease in LDL.

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