Investigation of the Synbiotic Effect of the fruit peel of *Musa ornata* and *Sesamum indicum* with Yogurt and Its Link to Antihyperlipidemic, Antihyperglycemic, and Hepatoprotective Activity on Experimental Mice

B. Pharm (Honors) Project Report

A project report submitted to the Department of Pharmacy, Faculty of Health and Life Science, Daffodil International University for the partial fulfillment of Bachelor of Pharmacy Degree.

Submitted To

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Approval

A project paper, **"Investigation of the Synbiotic Effect of the fruit peel of *Musa ornata* and *Sesamum indicum* with Yogurt and Its Link to Antihyperlipidemic, Antihyperglycemic, and Hepatoprotective Activity on Experimental Mice"** submitted to the Department of Pharmacy, Faculty of Health and Life Science, Daffodil International University, has been accepted as satisfactory for partial fulfillment of the requirement for the degree of Bachelor of Pharmacy and approved as to its style and contents.

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First and foremost, I would like to convey my heartfelt gratitude to the Almighty Allah for giving me the chance to study this subject, the capability to complete my project work, and the ability to write up the project results in order to fulfill the requirements for the Bachelor of Pharmacy degree.

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I would also like to give my appreciation to those lab attendants who have helped me take care of those mice and made sure their proper safety during experimental period

Declaration

I hereby declare that the project work title **"Investigation of the Synbiotic Effect of the fruit peel of *Musa ornata* and *Sesamum indicum* with Yogurt and Its Link to Antihyperlipidemic, Antihyperglycemic, and Hepatoprotective Activity on Experimental Mice"** is required for the completion of the Bachelor of Pharmacy (B.Pharm) program under the Faculty of Health and Life Science, Daffodil International University.

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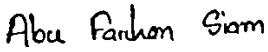

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ALL OF MY RESPECTED MENTORS AND MY FAMILY MEMBERS WHO HAVE SUPPORTED IN EVERY STEPS OF MY LIFE AND ENCOURAGED ME

Abstract

Hyperglycemia, cardiovascular disease, and hepatic dysfunction have become the most common chronic disorders in the present time. Conventional drugs have Some common side effects like abdominal discomfort, nausea, lightheadedness, or immune problems as well as hypotension and effect on hepatic functions. To eradicate those side effects to some extent as well as to increase the awareness of consumer about natural supplements, this in vivo experiment is performed to investigate the potential of ripe fruit peel of *Musa ornata* and *Sesamum indicum* and yogurt (sample) as a fiber source against Carlyle vegetarian capsules (standard) on Wister albino mice for 14 days (about 2 weeks) as an alternative to traditional sources. For investigation, the synbiotic source of Carlyle capsule (0.06 g/kg) and the fiber containing group [Peel 1.29 gm + Seed .75 gm +Yogurt] (Per 3 mice) were used throughout the total experiments. The SGPT level was within the normal range as compared to the control (40.33 ± 1.76 IU/L) where the value for the fiber combination was (34.07 ± 5.9 IU/L). Remarkably, the effect on OGTT level for the control group was noted at 7.65 mmol/L whereas the fiber combination group was 6.32 mmol/L. The fiber combination actively affects the lipid profiles by keeping them within a normal range. Among the lipid profiles for control groups, HDL was 49.14 ± 1.05 mg/dl and LDL was 54.11 ± 1.15 mg/dl in comparison to fiber source combination which was 35.08 ± 1.86 mg/dl, 43.90 ± 1.48 mg/dl sequentially. The HDL and LDL level in standard are 41 ± 5.70 mg/dl and 26.8 ± 3.70 mg/dl which indicates effect of fiber source in sample mice group. So, it is expected that the fiber mix assumes an extraordinary part in forestalling cardiovascular and hepatic problems. Further parameters of this area should be explored to expand the legitimacy of these assertions.

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Chapter-1
Introduction

1.1 General Introduction

Medication is something we take to eradicate or treat sickness or treat the side effects of illness or to avoid infection. Medication is the field including both the logical review and commonsense utilization of diagnosing, treating, and forestalling infections or diseases. This definition highlights the expansive extent of medication, which incorporates understanding, making do, and forestalling sicknesses.

On the off chance that we take a gander at the verifiable sense the meaning of medication is different from we are contemplating or suggesting, in ancient time, medication has been seen as an all-encompassing methodology including the body, psyche, and soul 4. It goes past the treatment of infections and envelops a more extensive comprehension of wellbeing and recuperating. Fundamentally, medication consolidates logical information, clinical practice, and restorative mediations pointed toward advancing wellbeing, forestalling sicknesses, and treating diseases in people.[1]

The historical backdrop of medication is a multidisciplinary field that analyzes the improvement of clinical practices, convictions, and baselines all through mankind's set of experiences. It includes the investigation of clinical information, medicines, innovations, and medical services frameworks from old developments to the current day. Understanding the historical backdrop of medication gives bits of knowledge into the advancement of clinical hypotheses, practices, and morals, as well as the social and political settings that have affected the act of medication over the long run. The history of medication as we know it has turned a different corner during each era and is a spellbound story of how a process becomes so important in our modern life from just a side way of treating diseases. The history of medication gives significant experiences into the intricacies of human wellbeing, the mission for clinical information and development, and journey to reduce enduring and further develop the prosperity of people and networks.[2]

The advancement of medication can be followed back to old developments where customary recuperating rehearses, like those of the Egyptians, Greeks, and Chinese, established the baseline for clinical information and medicines. These early exercises frequently elaborate an extensive methodology that thought about the interconnectedness of the body, psyche, and soul. In those times medication was not the essential preventive or treatment strategy among individuals. Over the long time, clinical information extended as various societies gave and took thoughts and practices. This accelerated the advancement of different clinical frameworks, like Ayurveda and Conventional Chinese Medication, each with its one-of-a-kind convictions and rules and medicines. The nineteenth and twentieth hundreds of years saw quick headways in clinical innovation, like the revelation of anti-infection agents, immunizations, and imaging strategies. These developments upset the finding and treatment of infections, fundamentally working on understanding results. In right now other moderately refreshed treatment technique which includes various treatments, chemical substitutions r altering how much synthetics in the body or controlling the maintenance time of medication in the body which have expanded the future as well as the conviction of individuals in prescriptions.[1]

Some difference between drug and modern medicine:

Drugs have always been both medicine and poison. Their function is cure but they can also have side effects and adverse effects; they. Drugs can be defined as preparations which use is inserted within a set of representations, practices, and social relationships. Acting as a mediator or sometimes as an issue. The medication and its use are far from the rational management of drugs as defined by public health authorities. The matter at stake can also be the legitimation of illness or pain.[3]

Moreover, only the main Ingredient which contains the active ingredients are called drugs but when they are mixed with bunch of excipients to increase their efficiency, stability and their effectiveness and appearance, they are called medicine.

Drug has some physiological effect when they are given in the body or introduced in the body, but they can have both positive and negative effect, but medicine is more stable and have lesser side effects since it is approved and regulated by governing bodies.[3]

Drugs are produced or formulated by the druggist or chemist, but the medicine is formulated by the pharmacist. As a means of legitimation, psychotropic drugs raise specific questions as there is no objectivation of symptoms, be them mood changes or pain, aside from the patient's account.

1.2 Influence of Plants in Traditional Medicine

Medicinal extract containing plants have a huge part in present day medication and medical services like:

Clinical Practice: Over hundreds of mixtures got from 90 plant species are at present utilized in clinical practice, 77% of these are taken from plants utilized in customary drugs. Around one fourth of the remedies overall are loaded up with drugs which are acquired or removed from plant sources. Out of the main 20 smash hits in the drug field, seven were viewed as either normal items or direct subordinates of regular mixtures, procuring billions of dollars every year.

Optional Plant Metabolites: There are around couple hundred thousand auxiliary plant metabolites on the planet, among them couple of thousand are separated. Therapeutic plants are a fundamental precursor of new medications and drugs. many updated drugs have been found or gotten from restorative plants, like ibuprofen (from willow bark), morphine (from the opium poppy) and what not.[4]

Medicinal plants play had a critical impact in customary medication from the beginning of time by being the reason for treating different illnesses and medical issue. The utilization of plants as medication goes back a prolonged period, with proof of their development for restoring purposes as far back as a long time back like 60,000 years ago. In old times, individuals depended on plants to fix ailments as there was restricted information about the reasons for sicknesses and the ways of treating them. Scripts about restorative plants have been found in old developments like India, China, Egypt, Greece, and Central part of Asia, having the well-established history of involving plants for therapeutic purposes.

Medicinal or by someone restorative plants have been utilized for regarding sicknesses as well as for keeping up with wellbeing and development of human health for long term.[5]

1.3 Influence of Medicinal Plants in Bangladesh:

Medicinal plants have been utilized in Bangladesh for a really long time for human government assistance, wellbeing advancement, and as medications and scent materials. They are fundamental in essential medical services frameworks, particularly in far off provincial networks. Wild assortments of spices by the unfortunate act as occupation exercises and a significant wellspring of money pay. Ayurvedic and Unani organizations utilize numerous restorative plant species as conventional prescriptions. The Public Medication Strategy of Bangladesh guarantees quality Unani and Ayurvedic prescriptions and medications.[6]

If we can gather some of the examples of medicinal plant presence in our life:

An essential component of both physical and emotional fulfillment is the stomach. Peptic ulcers, ulcerative colitis, and other symptoms are frequently caused by physiochemical imbalances and other chemicals that cause digestive problems. Even when non-steroidal anti-inflammatory medications are taken, their long-term consequences are unavoidable, and medicinal herbs can prevent them entirely.[7]

And for the common cold or some kinds of topical infection, people use natural medicinal plant parts like leaves, bark, or their extracts to treat their infected sites of the body.

Around 2 million people die each year from liver infections, of which 1 million are due to cirrhosis, 1 million to viral hepatitis, and 1 million to hepatocellular cancer. Liver infections are a major source of illness and death overall. The foundational building blocks for the development of credible hepatoprotective drugs are phytochemicals derived from common sources. Most of the regular sources whose dynamic mixes are being used are really employed in ethnomedicine.[8]

Chakma being the biggest clan of Bangladesh living in the Rangamati, Khagrachari, Bandar ban locale in Chittagong Slope Parcels district in the southeast piece of the country. The Chakma's have their own unmistakable language and customs, which incorporate their conventional restorative practices. In a new ethnomedicinal overview at Rangamati among the ancestral restorative professionals of the Baburo, Hadgu and different factions, it was seen that the specialists utilized a sum of 73 therapeutic plants for treatment of a different assortment of infirmities. Of the 73 absolute plants acquired, the therapeutic purposes of 33 plants were viewed as like Ayurvedic utilizes, as announced for different Ayurvedic arrangements. Ayurveda is the most established conventional restorative framework in the Indian sub-mainland dating back to some degree three to quite a while back despite everything being rehearsed in nations like India and Bangladesh. What is more, ayurvedic arrangement mostly conceited and relied on the plant with medicinal exercises.[9]

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1.4 Influence of Medicinal Plants Throughout the world

Numerous old social orders, including those of the Egyptians, Greeks, Romans, Indians, and Chinese, utilized restorative plants to fix many infirmities. These cultural establishments safeguarded their insight into recuperating plants in compositions like as the Papyrus and Ayurvedic writing, establishing the groundwork for medicinal plants delivered at home. Several things like Ayurveda, Conventional Chinese Medication, and Local Recuperating Frameworks, proceed to depend on therapeutic plants for their recuperating characteristics fully. These structures feature unique ways to deal with recuperation and prosperity that utilize plants' medicinal and preventive properties. Moreover, the impact of medicinal plants reaches out to present day medication. Many examples are gotten from plants, for example, quinine from willow bark and mitigating medicine from the cinchona tree. The utilization of restorative plants has additionally brought issues to light about the importance of biodiversity preservation. Numerous Medicinal plants are obtained from regular natural surroundings, featuring the requirement for maintainable collecting practices. Their restorative properties and social importance keep forming medication and add to the prosperity of people worldwide.[1]

Home grown medicinal items are getting worldwide significance due to their medical advantages. Their request will build due to expanded interest of customers in normal items as they are viewed as more secure. More financially savvy than manufactured drugs in many events. As per World Wellbeing Association (WHO) around 80% of the populace of most non-industrial nations depend on conventional natural medications for their essential medical service needs. Global exchange restorative plants and their items was US$ 60 billion of every 2010 and is supposed to arrive at US$ 5 trillion by 2050. In Asia, the interest in natural market had nearly multiplied during late 1990's because of expansion in populace. The Worldwide Nutraceuticals Market has been projected to ascend at more than 8.3% per annum to arrive at US$ 30 billion every 2015. An enormous number of food and drug organizations are dynamic in the field since they consider that the nutraceuticals market has promising development potential.[2]

1.5 Soluble and Insoluble fibers

Fibers are those ingredients which do not fully absorb in our digestive system because they do not have the necessary enzymes that will help them to be digested. Fibers are plant derived. Food consists of different chemical compositions like cellulose, starch, dextrin, inulin, lignin etc. Dietary fibers can be of Two types which are soluble fibers and insoluble fibers. Fiber has various kinds of functions in the body. Like lower the risk of heart diseases, lower the risk of strokes, lower the risk of type 2 diabetes, bowel cancers and other types of cancers and whatnot. Fibers, when entered the body, affect the rate of digestion of foods. As well as the movement of Waste products to the colon if we take healthy amount of Each of the fibers every day.

There are some basic differences between the soluble and insoluble fibers which are noted down:

- Soluble fiber is a dietary fiber which dissolves in water into a gel like substance but on the other hand, insoluble fiber does not dissolve in the water, though it is also a dietary fiber.

- Soluble fiber is quite easy to chew, but insoluble fiber is not so easy to chew, and it is a hard structure.
- Soluble fiber works in the lowering of cholesterol levels, reducing the risk of cancers and prevent the bowel Syndrome And on the other hand, insoluble fiber works in the easy defecation of waste materials from the body and reduce the risk of hemorrhoids and Constipation.[3][4]
- Soluble fibers can be found in oats, oatmeal, various kinds of vegetables, seeds, nuts, etc. but insoluble fibers can be found in the brand layers of cereal grains, nuts, seeds, potato skins and various kinds of colorful vegetables.

Function of Soluble fibers:

Soluble fiber is a type of dietary fiber which does not digest in our body. There are some specific functions of soluble dietary fibers. Which will be discussed below.

- Soluble dietary fibers. Drop cholesterol in the digestive tract. And this allows the soluble fibers to prevent them. Cholesterol. To be circulated into the bloodstream and absorbed by it. They trap the LDL or low-density Lipoprotein cholesterol. We all know that cholesterol is of two types which are LDL and HDL. LDL is a bad cholesterol. Which should prevent blood circulation.[5]
- Soluble fibers help to regulate the blood sugar levels to some extent and slow down sugar absorption into the bloodstream.[6]
- There are some beneficial bacteria in the gut of our body, especially in the small intestine and those soluble fiber act as prebiotic, which is beneficial for the enrichment of the bacterial health and those bacteria will help digest the foods into our body. They also act as a promising treatment of cancer by reducing their cellular proliferation.[7]
- Soluble fiber attracts and absorbs the water more than normal foods. That is why they help to soften the stool. That is why they are useful for reducing Constipation.[8]
- Soluble fiber also strengthened the gut barrier, which is especially useful. To be protected from harmful toxins and bacteria.

Function of Insoluble Fibers:

Insoluble fiber does not dissolve in water, but they have some extensive function in our body's normal regulation. Some important function of insoluble fiber in our body Including:

- Though it does not dissolve in the water, it acts as a bulking agent which adds size to the materials that softens the stool. That helps to treat the Constipation.
- since we know that soluble fiber helps the gut bacteria to get their essential energy, two digest the foods properly, but the insoluble fiber does not act as a food for the gut bacteria. They are basically. Work on the environment of the gut bacteria so that the gut bacteria can digest the foods more efficiently.[9]
- Nowadays most people suffer from cancer. And they have become a common phenomenon. There is no Known treatment for cancer that can specifically treat the cancer.

We have chemotherapy and radioactive therapy, but they do not specifically act on the cancer cells. But if we try the insoluble fiber or insoluble fiber enriched foods, they have been shown promising results in the treatment of cancers. We know that cancer spreads into our body by cellular proliferation. If we can stop the cellular proliferation there will stop spreading from one organ to another, and insoluble fiber and soluble fiber ingredients do just that.[7]

- We already know that insoluble fiber acts as a bulking agent for the body. And for this Reason, the softeners tool and as a result Insoluble fiber promotes the healthy bowel movement.
- There can be many kinds of toxins or many kinds of harmful materials in our gut, and we know that Insoluble fiber eliminates from the body Without proper digestion, since there is no enzyme for the digestion of those kinds of fibers. But insoluble fiber can bind with those toxins and other harmful substances that are present in our gut and can be removed with them. And for this reason, our gut can remain healthy.[4][3]
- Insoluble fiber actors and bulking agent that we have mentioned earlier and for this reason if we take insoluble fiber on a daily basis, it can reduce Appetite Since if we take it regularly We will feel less hungry and for this reason our calorie intake will be less and it will help us to manage our weight.[10]

Daily Intake of fiber amounts:

In USA, the normal amount of fiber intake Is about 20 to 35g. According to the age of the of the person and according to the gender. But the amount remains in the range of 20 to 35 Gram. and on the average of 30 Gram. But if someone has diabetes mellitus type 2, they can have about 24 to 28g of fiber intake in which up to 8g is soluble fiber and 16 gram of those fiber amount is coming from the insoluble fiber. People who have insufficient fiber amount in the body can have a larger amount of fiber. Diet consists of 50 grams per day. In which 25g comes from the soluble Source. and 25g grams from the insoluble source.[11]

In the UK, that daily amount of fiber intake is about 30 grams, which includes Both soluble and insoluble fibers.[12]

In some theories, for adults, the recommended acceptable intakes of dietary fiber are 28–36 g/day and out of that, 70–80% must be insoluble fiber.[10]

1.6 Synbiotics and It's influence on human health promotion

Functional food sources are wellbeing advertisers, and their utilization is related to diminished hazard of persistent degenerative and non-contagious illnesses. Models are advantageous. The relationship of (at least one) probiotic with a one (or more) prebiotic is called cooperative, being the prebiotics correlative and probiotics synergistic, in this manner introducing a multiplicative variable on their singular activities

The utilization of synbiotic might advance an expansion in the quantity of bifidobacteria, glycemic control, decrease of blood cholesterol, adjusting the digestive verdure which helps with diminishing blockage and additionally loose bowels, works on gastrointestinal porousness and

excitement of the resistant framework. Clinical signs for these items have been extended, to boost the person's physiological capabilities to give more prominent. In this way, with the exorbitant interest in the clinical and healthful control of sickness, many examinations have been led exhibiting the viability of utilizing advantageous in improving and additionally forestalling different or potentially side effects of gastrointestinal illnesses.

The utilization of synbiotics has been broadly considered and shown as a promising option for use in blend with anti-toxins or segregated. Restore the microenvironment upgrades gastrointestinal assimilation and expands the insusceptibility of patients[13]

The utilization of practical food varieties, especially harmonious, has been augmented by diet treatment fully intent on further developing the wellbeing status of patients with specific tumors. It is normal the event of changes in the organization of the human gastrointestinal vegetation which can be adjusted by ecological and dietary variables leaning toward perioperative contaminations. [14]

Treatment with synbiotics might be a great procedure in the anticipation and decrease of postoperative contaminations. The extent of the impact relies upon the sort of cooperative arrangement and centralization of the microorganism in the compound[15][16]

Image 1: Prebiotic + Probiotic Capsules

Image Source: https://healthplus.com.bd/wp-content/uploads/2023/12/Carlyle-50-Billion-CFU-Probiotic-Prebiotic-Postbiotic-Supplement-60-Capsules-Bottle.png

1.7 Herbal Drug research approach

Lots of books are available in the market based on herbal medicinal practice. Among them lots of plants are still not investigated. Pharmacological screening is important to find out the active compound responsible for traditional use. Spectroscopic and chromatographic methods can be used to isolate the therapeutically active compound for further studies. There are some stages where we can research the lead compound:

I. Extraction of bioassay-directed plant divisions involving different natural solvents in the request for expanding extremity record.

II. Normalization and portrayal of the separated divisions for the improvement of intense and safe medication competitors.
III. Detachment of bioassay-directed dynamic homegrown divisions from the rough concentrate utilizing procedures like dissolvable fractionation, preparative slim layer chromatography (attention), and segment chromatography.
IV. Streamlining of lead bioactive parts using various solvents in a rising request of extremity file to acquire various divisions for bioactivity testing. Testing and evaluation of the bioactive lead parts through procedures like superior execution fluid chromatography (HPLC), elite execution dainty layer chromatography (HPTLC), fluid chromatography-mass spectrometry (LC-MS), atomic attractive reverberation (NMR), and so forth.
V. Assessment of the upgraded bioactive portions for their potency for longer period.[17]

1.8 Potential Drug discovery approach from medicinal Plants

For any kind of essential drug discovery, there are some criteria that needs to be met and after that It is trialed by people and then it is marketed. And the entire process is noted down step by step:

- The first step is to discover the medicinal plant Which will act as a source of our lead Compound.
- After determining the medicinal plant and lead compound, we must isolate those compounds from them for further study.
- After that we must study About the potency of the lead compound and how it is interacted with the target cells or the infected cells Which will be treated with this lead compound.
- We must further study how the lead compound interacts with other cells of the body.
- After this process, we must administer those lead compound into a living Organism to identify its potency as well as the interaction of the lead compound with those living organisms.
- After administrating those compounds into living organisms, we must optimize the efficacy of those parameters and understand the behavior of those compounds in the living organisms.
- We must evaluate the pharmacology, the toxicology, the ADME or the pharmacokinetic actions as well as the pharmacodynamic actions of the lead compound and we must understand the adverse effect, the side effect, and other kinds of effect on the lead compound into the body. Other than the fact that it will treat specific kinds of disease.
- After that, we must. Create a clinical trial for those lead compounds, and we must understand that only a minimal amount of lead compound can be marketed after clinical trials because the chance of passing the clinical trials is extremely low.[18]

Utilizing refined trend setting innovation will assist conventional experts with controlling such sort of creation strategies. A main issue involving trend setting innovation for the creation of customary medication is the last readiness may not be OK to the specialist since he has solid confidence in unpremeditated arrangements. These issues can be defeated by limiting the

hindrances of old strategies and utilizing the benefits of new techniques through an approved way. Involving therapeutic plants as a natural substance in the drug industry is an extraordinary wellspring of unfamiliar trade for any country.

1.9 Hyperlipidemia

Hyperlipidemia is a disease which is caused by the higher amount of cholesterol in our Body. Cholesterol is a type of lipid. Which causes when there is more amount of fat in our body. Cholesterol can be two types which are LDL and HDL. HDL is particularly good for our body because it carries bad cholesterol to the liver so that they are metabolized. But LDL, which is called the bad cholesterol Which. Stores in our blood vessel arteries cause plaque formation, called atherosclerosis which can hinder the blood circulation in the blood vessels and that causes Different kinds of diseases like heart attack, congestive heart failure and strokes.

Hyperlipidemia partitions into two expansive groupings which are essential (familial) or optional (obtained) hyperlipidemia. Essential hyperlipidemia gets from a plenty of hereditary issues that a patient might acquire through birth, while optional hyperlipidemia regularly starts from another fundamental etiology, like an unfortunate eating routine, drugs (amiodarone, glucocorticoids), hypothyroidism, uncontrolled diabetes, or potentially an unfortunate way of life routine.[19]

Cholesterol	Cholesterol Level	Category
Total Cholesterol	Less than 200 mg/dl	Desirable level.
	200 to 239 mg/dl	Borderline high for heart disease.
	240 mg/dl and above	High blood cholesterol. A person with this level has more than twice the risk of heart disease as someone whose cholesterol is below 200 mg/dl.
HDL Cholesterol	Less than 40 mg/dl	Low HDL cholesterol. A major risk factor for heart disease.
	40 to 59 mg/dl	The higher HDL level, the better.
	60 mg/dl and above	High HDL cholesterol. An HDL of 60 mg/dl and above is considered protective against heart disease.
LDL Cholesterol	Less than 100 mg/dl	Optimal
	100 to 129 mg/dl	Near or above optimal
	130 to 159 mg/dl	Borderline high
	160 to 189 mg/dl	High
	190 mg/dl and above	Very high
Triglyceride	Less than 150 mg/dl	Normal
	150-199 mg/dl	Borderline high
	200-499 mg/dl	High
	500 mg/dl and above	Very high

Basic aggravations in lipoprotein digestion are frequently familial, making a patient's family ancestry more significant. For instance, around 54% of patients (in one review) with a background marked by untimely coronary corridor illness had a hidden genetic problem. In many patients, hyperlipidemia has a polygenic legacy example, and signs of the problem are impacted by optional factors, for example, (focal) heftiness, soaked fat admission, and the cholesterol content inside an individual's eating routine. Different less regular gambling elements will likewise show up beneath.[20]

Cholesterol is the flowing greasy substance, most embroiled in the atherogenic cycle. Its starting point is twofold: 300 to 700 mg each day is of exogenous beginning coming from an extreme admission of dietary fats, particularly of creature beginning; 800 to 1200 mg (about the weight of a small paper clip) each day is crafted by an endogenous blend, specifically the liver. Notwithstanding over the top utilization of creature fats, other continuous reasons for hypercholesterolemia or potentially expansion in fatty oils are diabetes, ongoing renal disappointment, nephrotic condition, hypothyroidism, age, stationary way of life. Other iatrogenic causes might be the admission of specific medications like thiazide diuretics, beta-blockers, estrogen-progestin contraceptives, antiretrovirals.

There are north of 3,000,000 grown-ups all through the US and Europe that as of now have a conclusion of hyperlipidemia, and that number keeps on ascending at a radical speed. Hyperlipidemia is normally a constant, moderate infection process that requests way of life and dietary changes, with the possible requirement for extra lipid-bringing down prescriptions. The level of hyperlipidemia is most noteworthy in patients with untimely coronary conduit sickness (computer aided design), characterized as computer aided design emerging in guys before age 55 to 60 years and females before age 65 years. Under the earlier determined conditions, the rate of hyperlipidemia is around 75-85%, went against to about 40 to 48% in the control populace of similar age, yet without the presence of untimely coronary corridor illness[20]

1.10 Hyperglycemia

Hyperglycemia Refers to the term where abnormal amount of blood glucose level is situated in our body. Normally when we take foods for our nutrients, they produce Glucose that is then metabolized by our cellular organisms and then it generates the energy that we need for our normal body regulation. There are some specific amounts of sugar that we need every day, but when the amount of sugar is excess than our limit then it is called the hyperglycemia situation. Sometimes we take various kinds of food and that increases our blood glucose level for a brief period. That is not a complicated thing because the amount of sugar decreases Overtime. Hyperglycemia refers to the term where abnormal blood glucose level is in our body. That is called chronic hyperglycemia situation. This chronic situation can arise some difficulties and some disease in our bodies such as:

a) Nerve damage.
b) Blurred vision and retinal complication.[21]
c) Kidney damage.
d) Chest pain and Heart attack.

e) Brain stroke.
f) Diabetes mellitus.

The most frequent problem of chronic hyperglycemia is called diabetes mellitus. There are two kinds of diabetes mellitus, which are type one and type 2. Type one diabetes mellitus occurs when there is not enough insulin to metabolize the glucose into our cellular Organism, and type 2 diabetes mellitus occurs when there is enough insulin. In our body to metabolize the glucose, but the sensitivity of the cells against the insulin is higher Than normal, that is why the Proper entry and metabolism of blood glucose does not occur. The Global Diabetes League (IDF) assessed a general pervasiveness of diabetes mellitus to be 366 million by 2011, and anticipated an ascent to 552 million by 2030.[22]

Threatening growths are frequently multifactorial. Epidemiological examinations have shown hyperglycemia raises the pervasiveness and mortality of specific malignancies, like bosom, liver, bladder, pancreatic, colorectal, endometrial tumors. Hyperglycemia can advance multiplication, attack and movement, prompt apoptotic obstruction and upgrade the chemoresistance of growth cells. This survey centers around the new discoveries in the connection between glycemia and growth advancement.[23]

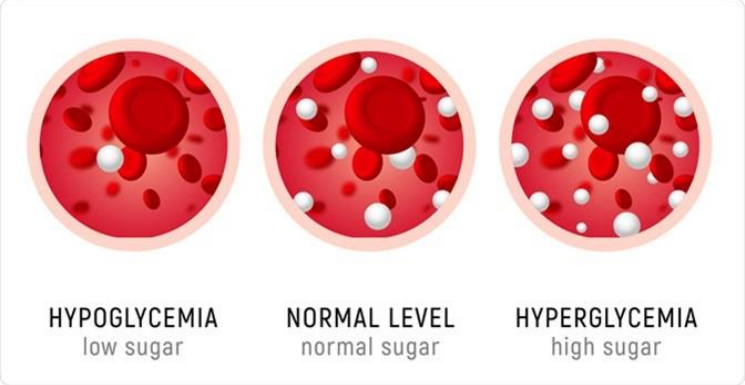

Image 2: Glucose Level in Circulation

Image Source: https://d2jx2rerrg6sh3.cloudfront.net/image-handler/ts/20200316120923/ri/673/picture/2020/3/%40shutterstock_1403010278.jpg

There is a connection between cardiovascular disease and chronic hyperglycemia and there are many research articles about this. The job of hyperglycemia-intervened actuation of nonoxidative glucose pathways (NOGPs) [i.e., the polyol pathway, hexosamine biosynthetic pathway, high level glycation results (AGEs), and protein kinase C] in this cycle is widely evaluated. The proposition is made that there is a special transaction among NOGPs and a downstream union of unfavorable impacts that particularly influence heart endothelial cells, in this manner adding to contractile brokenness. In this cycle the AGE pathway arises as an essential middle person of hyperglycemia-intervened unfavorable impacts.[24]

1.11 Hepatotoxicity

Hepatotoxicity is defined by the damage of liver, which is caused by the chemicals. We know that all the drugs and chemicals that we consume during our lifetime is regulated and metabolized and excreted with the help of liver and when the liver Is affected by chemicals, they do not function well, and they start to damage. Hepatotoxicity, or liver toxicity, is caused by two reasons which are:

- The first one is called drug induced liver injury. It is the most common type of liver injury, caused by over-the-counter medications. During our lifetime, we use distinct kinds of medicine. All the medicines are chemicals in the end, so we had to consume those medicines in a limit. When we take medications on a chronic basis or when we take a particular medication over the limit of the dose amount, they tend to damage the liver.
- Another kind of liver toxicity, also called idiosyncratic toxicity or hepatic toxicity, type B Which is caused by various kinds of. Gaming girls or toxins, but which is not particular. [25]

Particular (type B) injury happens all of a sudden, when specialists cause non-unsurprising hepatotoxicity in powerless people, which isn't connected with portion and has a variable dormancy period.[25]

Over 1000 drugs caused liver damage[26] if we do not take with their limited doses forms and among the hepatotoxicity, more than 50% of the people are suffering from drug induced liver injury type of liver toxicity.[27]

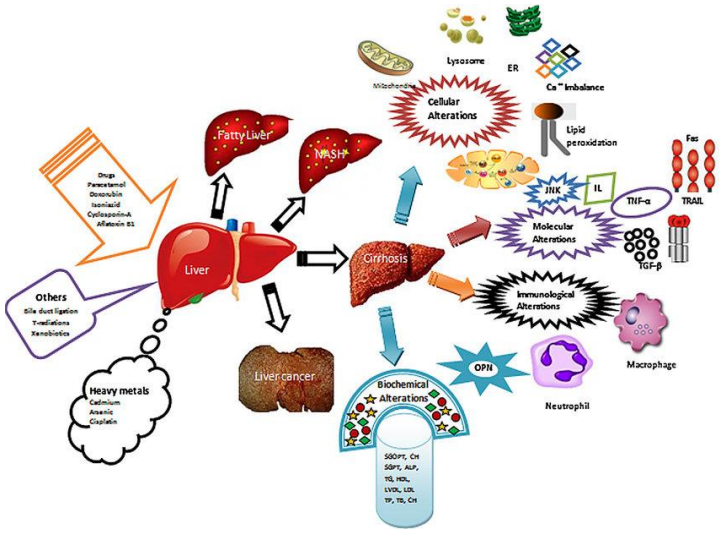

Image 3: Different Liver Toxicity
Image Source: Models of hepatotoxicity and the underlying cellular, biochemical and immunological mechanism(s): A critical discussion.[28]

The chemicals that cause liver injury are called hepatotoxins or hepatotoxicants. Hepatotoxicants are exogenous mixtures of clinical importance also, and may incorporate excesses of specific restorative medications, modern synthetic compounds, natural cures, and dietary enhancements. Certain medications might cause liver injury when presented even inside the restorative reaches. Hepatotoxicity may result not just from direct poisonousness of the essential compound but in addition from a receptive metabolite or from an immunologically intervened reaction affecting hepatocytes, biliary epithelial cells as well as liver vasculature. The hepatotoxic reaction inspired by a synthetic specialist relies upon the centralization of the poison which might be either parent compound or harmful metabolite, differential articulation of chemicals and focus angle of cofactors in blood.[29]

We have already mentioned earlier that dietary fiber has extensive function in our body regulation and body's prevention and treatment of diseases. Dietary fibers which include both soluble and insoluble fibers which act as prebiotics and probiotics like Sour curd (good microorganisms which promote good gut health) combinedly help to reduce hyperglycemia, hyperlipidemia, hepatotoxicity. In this research we will test those parameters and will try and establish that those dietary fibers have extensive function in the anti-hyperlipidemic, antihyperglycemic and hepatoprotective areas. They can act as antihyperglycemic agent by reducing the sugar level in the blood, Act as an anti- hyperlipidemic agent by lowering the LDL or low-density lipoprotein cholesterol and as a hepatoprotective agent by reducing the liver toxicity by drugs or other kinds of miscellaneous chemical agents.

1.12 Yogurt

Yogurt is made by aging milk with live microscopic organism cultures. These microscopic organism societies give yogurt its tart flavor and furthermore give the probiotic benefits.

There are two principal sorts of probiotic microbes usually tracked down in yogurt:

- **Lactobacillus:** This sort of microscopic organisms is useful for separating lactose, the sugar tracked down in milk.
- **Bifidobacteria:** This kind of microbes can assist with lessening the runs, obstruction, and swelling.

Image: Yogurt

Image Source: https://storage.sg.content-cdn.io/cdn-cgi/image/width=1000,height=1500,quality=75,format=auto/in-resources/8845e144-8902-4204-b80f-9dc7dc2f4bcb/Images/ProductImages/Source/2500372%20Milk%20Vita%20Sweet%20Curd%20500ml.jpg

Chapter-2
Plants Profile

A) Musa ornata

2.1 Plant Identification

- **Botanical name:** Musa ornata
- **Local name:** Sagor Kola
- **Family:** Musaceae
- **General Use:** Fruit
- **Use in this research:** Dried peel of the fruit

Synonyms

- *Musa acuminata*, (cavendish banana)
- *Musa balbisiana*, (plantain)
- *Musa paradisiaca* (edible banana)
- *Musa coccinea (scarlet banana)*
- *Musa velutina (pink banana)*
- *Ensete ventricosum (snow banana)*
- *Ensete glaucum (false banana)*

2.2 Taxonomical classification of "*Musa ornata*"

Kingdom	Plantae
Clade	Tracheophytes
Clade:	Angiosperms
Clade	Monocots
Order	Zingiberales
Family	Musaceae
Genus	Musa
Section	Musa sect. Musa
Species	*Musa ornata*

2.3 Geographical distribution

Native to southeast Asia, *Musa ornata* is usually found in Bangladesh, Myanmar, and India. Although this species is widely distributed in tropical regions, it is often given the wrong name. The plant, which is quite lenient, was discovered around 1805 in Mauritius, an island off the coast of Madagascar, and it began to spread before it was first depicted organically on Indian banana plantations in 1824. Some theory shows that there has been conjecture on the evolutionary ties between this species and its Asian relatives due to its natural existence in Mexico. This study investigated the more plausible theory on the beginnings of this species' distribution and looked at the phylogenetic links between intercontinental specimens of the species based on registered evidence.[30]

The plant has also become regional in several parts of Mexico, though the seedlings are frequently sold commercially under the name *Musa violacea.*

2.4 Morphology of the Plant

Plant size and habit

The green, thin pseudo stems of plants can reach a height of three meters. They begin as light green, extremely waxy, and have black spots at the upper part. Generally, grows in the country where topical climate is present like Bangladesh and Mayanmar.

Rhizome

The rhizome is the starting point for banana growth. The rhizome is the plant's true stem. Both the plant root system and clonal plants are produced by this procedure. The characteristic of a rhizome is its subsurface horizontal development. Rhizomes can also develop many nodes that can be separated and replanted to create new plants.

Leaves

The color of the leaves is medium-dark green, with reddish midribs. The leaf can have dimensions of up to 2 m by 0.35 m and be connected to petioles that can reach 0.6 m in length. The leaf has an oblong form with an unevenly sided base and terminated tip.[31]

Suckers

The plant freely develops suckers, which appear near to the parent plant. Produces pink bract-adorned inflorescence that is upright. Water suckers and sword suckers are the two kinds of suckers that exist. Sword suckers have broad rhizomes and slender leaves. Water suckers have a little banana plant-like appearance. They will not become powerful plants because of their large leaves, short rhizomes, and weak ties to the mother plant.

Fruits

Fruits are produced in little bunches. Depending on the cultivar, individual fruits can grow up to 10 cm (about 3.94 in) long and have either a pink or purple hue while they are weng. When ripe, they become greenish yellow.

Seeds

Black seeds are used. Used in bulk plantings or as a focal plant. Fit for receptacles. Plants do best in semi-shaded environments, yet they may be trained to flourish in full light. Plants grown under brighter light will grow shorter.

Inflorescence

The bunch, rachis, and peduncle make up the three components of the inflorescence. The stalk that holds the flower in place and connects it to the rhizome is called the peduncle. The bracketed stalk that extends from the first fruit to the male is called the rachis. The fruit on the rachis is referred to as the "bunch." We cut the peduncle and hang it upside down by the rachis to continue ripening after the bunch starts to turn yellow.

Image 4, 5: Musa ornata

Image Source:(https://www.gardenia.net/wp-content/uploads/2023/05/musa-ornata-780x520.webp) (https://eureka-farms.com/cdn/shop/collections/Banana_SSR.jpg?v=1699294252)

2.5 Phytochemical screening of *Musa ornata*

It is described as the process of identifying various classes of phytoconstituents that are present in different parts of the base for drug discovery; the active components may then be further investigated and researched; alternatively, it refers to the process of extracting, screening, and identifying medicinally active substances that are obtained from plants.[32]

Phenolic chemicals, aromatic amino compounds, lipids, carbohydrates, and proteins are among the chemical components of banana plants, more especially the sap. One of the main components are phenolic compounds, which also include lignans, stilbenes, phenolic acids, and flavonoids (flavanones, flavones, flavanols, flavonols, isoflavones, and anthocyanins). Banana sap has also been shown to include dopamine, N-acetylserotonin, hydroxycinnamic acids, apigenin glycosides, naringenin glycosides, and flavonol glycosides. These substances have a variety of functions in plants and may be favorable to human health. They also act to reduce and treat different kinds of diseases.[33]

Constituents in banana peel

- **Phenolic compounds:** Known for their antioxidant properties which helps to reduce the amount of free radicals and reduce the chance of cancer

- **Triterpenes:** Studied for potential pharmacological activities.
- **Carotenoids:** Pigments with antioxidant properties.
- **Amino acids:** Essential for various biological processes and hormone production
- **Dietary fiber:** Important for digestive health and overall health system.[33]

2.6 Medicinal Properties

- Nutrient-dense bananas are packed with vital vitamins (C, B6), minerals (potassium, magnesium), and fiber that support heart health, blood sugar regulation, and digestion.
- Banana leaves have long been valued for their anti-inflammatory and antioxidant qualities. They are frequently used to wrap food as it cooks to add healthy ingredients to it.
- Because of their antioxidant content, banana blossoms are used in traditional medicine to treat oxidative stress in the body. They are also tasty.
- Because of the stem's anti-inflammatory and antibacterial qualities, renal health and kidney stone prevention have long been associated with the use of the stem's juice.
- Banana roots are believed to have diuretic and antimicrobial qualities in traditional medicine, which may help the digestive system.[34]

Banana peels medicinal properties

- **Antioxidant Properties:** Banana peels include antioxidants such as polyphenols and carotenoids.
- **Antibacterial Properties:** Compounds found in banana peels have antibacterial and antifungal properties.
- **Wound Healing:** Applying banana peels to small wounds uses their antibacterial characteristics to help avoid infections.
- **Skin Health:** Helps moisturize the skin, decrease inflammation, and perhaps treat disorders such as acne and psoriasis.
- Banana peels contain fiber that improves gut health, perhaps relieving constipation and increasing digestive function.
- Banana peels regulate cholesterol and blood pressure.[35]

2.7 Traditional use of *Musa ornata*

Banana pulp and peel, for example, can be utilized as natural sources of antioxidants and pro-vitamin A since they include carotenoids, phenolics, and amine compounds. To build a phytomedicine or even an allopathic medicine.[36]

The flowers of the banana plant are used to treat bronchitis, dysentery, and ulcers; cooked flowers are given to diabetics; the astringent plant sap is used to treat hysteria, epilepsy, leprosy, fevers, hemorrhages, acute dysentery, and diarrhea, as well as hemorrhoids and insecticides.

The astringent ashes of the unripe peel and leaves are used to cure dysentery and diarrhea, as well as malignant ulcers; the roots are used to treat digestive problems, dysentery, and other

diseases; and banana seed mucilage is given to those suffering from diarrhea in India. The peel and pulp of fully ripe bananas contain antifungal and antibacterial properties. The antibiotic works against Mycobacterium. A fungicide found in the peel and pulp of green fruits works against a fungal disease that affects tomato plants. Norepinephrine, dopamine, and serotonin are all found in the ripe peel and pulp. The first two raise blood pressure, whereas serotonin suppresses stomach secretion and promotes intestinal smooth muscle.[37][38]

B) Sesamum indicum

2.8 Plant Identification

Botanical name: *Sesamum indicum*
Local name: Gingelly, sesame, and til
Family: Pedaliaceae
General Use: Oil extraction
Use in this research: Black seeds as fiber source

2.9 Taxonomical Classification of "*Sesamum indicum*"

Kingdom:	**Plantae**
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Lamiales
Family:	Pedaliaceae
Genus:	Sesamum
Species:	*Sesamum indicum*

2.10 Geographical distribution

Sesame (Sesamum indicum L.) is one of the first human-produced and consumed oil crops in the Pedaliaceae family, which also includes rape, soybeans, and peanuts, China's four primary oil crops. Sesame, which was first identified in Pakistan. It is available in nations like India, China, and Malaysia. For almost 5000 years, Chinese people have utilized sesame seeds.[39] India, Sudan, Myanmar, China, and Tanzania are the world's largest producers of sesame. Sesame seed output in African countries has expanded in recent years. According to the Food and Agriculture Organization of the United Nations, worldwide sesame production in 2017 was 5.899 million.[40]

Sesame has always been valued because of its capacity to thrive in regions where other crops cannot. It is also a strong crop that requires minimal farming support and it flourishes in drought conditions, high heat, with leftover moisture in the soil after the monsoons have passed, or even when rains fail or are excessive. It was a crop that subsistence farmers could plant on the outskirts of deserts where no other crops thrived. Sesame has been labeled a survival crop.[41]

2.11 Morphology of *Sesamum indicum*

Stems

Stems range in hue from purple to light green, growing straight and angular to a height of 1-1.5 meters. They have a longitudinal furrow with a square or broad rectangular form that can be hairy or smooth, depending on the type.

Leaves

Sesamum indicum leaves are 3–17.5 cm long and 1–7 cm wide. They are dark green, with blue or yellowish tones when hairy. The leaves are present in a variety of patterns, including opposing, mixed, and alternating, with lower leaves lobate, middle leaves toothed and elliptical, top leaves are also in a pattern.

Seeds

The hulled seeds are creamy or pearly white, approximately 3 mm (0.1 inch) long, and have a flattened pear form. When the seed capsules dry, they open and the seeds spread. To avoid seed loss, harvesting requires a significant amount of human effort.

Flowers

Flowers have black patterns and appear in mauve-pink, pink, or white hues. We see them in the leaf axils and upper sections of branches and stems. The number of nodes on the main stem where flowers grow is a heritable trait, with individual flowers in lower leaf axils and multiple flowers on upper branches or stem sections.[42]

Image 6: *Sesamum indicum* flower

Image Source: https://mygardenlife.com/wp-content/uploads/2022/12/6061_6-1.jpg

Image 6: *Sesamum indicum* black seeds

Image Source: https://www.viralspices.com/wp-content/uploads/2018/07/black-sesame-seeds-2.jpg

2.12 Phytochemical screening of Sesamum indicum

It is described as the process of identifying various classes of phytoconstituents that are present in different parts of the base for drug discovery; the active components can then be further investigated and researched; alternatively, it refers to the process of extracting, screening, and identifying medicinally active substances obtained from plants.[32]

- Sesamol is major areas of strength for a cell reinforcement that forestalls lipid peroxidation.
  Tocopherols (Vitamin E) incorporate alpha-and gamma-tocopherol, with alpha-tocopherol being the more dynamic sort.

- Fundamental unsaturated fats incorporate linoleic corrosive and oleic corrosive.

- Minerals incorporate calcium, potassium, iron, magnesium, zinc, copper, manganese, and sodium.

- Proteins are fundamental for various organic cycles.

- Other advantageous synthetic substances incorporate sesamin, sesamolin, and lignans. [43]

  The entire plant and leaves of Sesamum indicum are high in protein. Various bits of the plant, especially the roots, have calculable sums. They have a high lipid content, which makes them a brilliant wellspring of eatable oils. Sesamum indicum is plentiful in minerals like calcium and potassium. Dampness content varies all through the plant, with roots having more prominent sums. Additionally, Different parts of the plant have significant amounts of debris content.
  Phytochemicals incorporate flavonoids, alkaloids, tannins, lignans, phenolic acids, and saponins.[44]

2.13 Medicinal Properties of *Sesamum indicum*

- Sesamum indicum (sesame) has various restorative attributes and has been utilized in customary medication for a long time. These characteristics incorporate the accompanying:

- Cell reinforcement Properties: Sesamum indicum incorporates flavonoids and different phytochemicals that capability as cancer prevention agents, lessening oxidative pressure and aggravation.[45]

- Calming Impacts: The phytochemicals found in Sesamum indicum have mitigating characteristics that can assist with overseeing aggravation related sicknesses.

- Conventional Restorative Purposes: Sesamum indicum roots, leaves, and seeds have all been utilized to treat an assortment of wellbeing diseases, including catarrh, eye uneasiness, skin issues, and, surprisingly, as a hair wash.

- Nourishing Advantages: Sesame seeds are plentiful in key parts including protein, carbs, and minerals, making them a useful dietary enhancement with conceivable medical advantages.

- Sesame seeds' high lipid content contains essential unsaturated fats that assist with working on broad wellbeing, especially cardiovascular wellbeing.

- Phytochemicals: Sesamum indicum incorporates a scope of phytochemicals, including lignans, phenolic acids, flavonoids, saponins, and alkaloids, which add to its helpful characteristics.[46][44]

Types of sesame seeds

Sesame seeds come in various assortments, the most widely recognized being white and dark. Every variation has its special piece and therapeutic purposes. Dark sesame seeds are prestigious in customary Chinese medication, frequently recommended to upgrade kidney and liver capability and advance hair development.

White sesame seeds, then again, have been used for their high calcium content, adding to bone wellbeing. They additionally contain sesamin and sesamolin, two exceptional substances that have been connected to bringing down cholesterol and forestalling hypertension in conventional medication.[47]

Medicinal properties of black sesame seeds

Cancer prevention agent properties: Sesame seeds contain cell reinforcements like sesamol, tocopherols, and lignans, which shield cells from oxidative harm and lessen irritation.

Cardiovascular wellbeing: The unsaturated fats in sesame seeds, particularly oleic corrosive and linoleic corrosive, reduce cholesterol levels and inhibits the gamble of cardiovascular illnesses.

Bone wellbeing: Sesame seeds are a decent wellspring of calcium, zinc, and magnesium, fundamental for keeping up with bone wellbeing and forestalling osteoporosis.[43]

Glucose guideline: Studies propose that sesame seeds might assist with controlling glucose levels and further develop insulin responsiveness, gainful for people with diabetes.

Stomach related wellbeing: Wealthy in dietary fiber, sesame seeds help processing, support stomach wellbeing, and forestall obstruction.[48][44]

2.14 Traditional Use of Sesame seeds

I. Sesame seeds contain lignans and phytosterols, which are plant intensifies that can assist with bringing down cholesterol. Phytosterols are additionally accepted to upgrade our invulnerable reaction and diminishing our gamble of specific malignant growths.
II. The sesamin and sesamolin in sesame seeds are known for their cancer prevention agent and antibacterial properties. Cancer prevention agents are vital to our wellbeing since they safeguard our body against different illnesses by dialing back harm to cells.
III. Sesame seeds can likewise dispose of the microscopic organisms that cause plaque on our teeth. An old practice called oil pulling is displayed to work on our oral cleanliness and wellbeing when drilled routinely.
IV. Type 2 diabetes is a long-lasting illness that doesn't permit our body to make insulin in the manner it ought to. Eating good food sources like sesame seeds can assist individuals with type 2 diabetes arrive at their objective glucose levels.[49] Also, the cancer prevention agents in sesame oil diminish how much sugar in our blood.

Chapter-3
Literature Review

3.1 Preview of literature review

In this project paper I have tried to Establish that synbiotic approach has an effective activity on anti-hyperlipidemic, antihyperglycemic and hepatoprotective function and can promote gut health.

Synbiotic foods are defined as the combination of Prebiotics and probiotics. Prebiotics are defined as the non-digestible fibers that hails for the promotion of our gut and probiotics are defined as the healthy and friendly bacteria that live in our bodies, especially in the gut area and promote normal health and treatment of many diseases. Though there are no enzyme for metabolizing the prebiotics or non-digestible fibers in our body, they can be used as a food which can be consumed by the probiotics or healthy bacteria that can be helpful for their growth, and they can act as a helpful entity for our hour bodies growth.

From a more extensive perspective synbiotic foods allude to an organization of interconnected components inside the pecking order that coordinate for common advantage. This can envelop different partners cooperating to make a more supportable and fair food framework.

In my project I have tried to establish that Combination of psychotics and probiotics which is also called synbiotics along with yogurt can have anti hyperlipidemic, antihyperglycemic and hepatoprotective activity Which covers Major 3 sectors of our disease Nature.

Now let us discuss some of the other journal articles that have the same interest and same knowledge and same kind of information that we are trying to discover and see if they are interested, or research have an alignment with ours.

3.2 Nutritional, Medicinal and Industrial Uses of Sesame (*Sesamum indicum L.*) Seeds - An Overview

Sesame seeds, which are cultivated for centuries, known as a protein-rich source of oil used in food, medicine, and cosmetics. Special components in sesame seeds may help lower cholesterol including HDL which is considered as good cholesterol and LDL which is known as bad cholesterol and blood pressure. Sesame oil, rich in antioxidants, might even have cancer-preventive qualities. Additionally, sesame seed oil is being explored as a potential biofuel alternative. With its long history and diverse uses, sesame remains a valuable crop with promising future applications.[46]

3.3 Chapter 122 - Sesame (*Sesamum indicum L.)* Seeds in Food, Nutrition, and Health

Sesame seeds, a health food high in g-tocopherol and vitamin E, have been used for generations to prevent heart disease and other age-related illnesses. Sesame oil, a versatile cooking and salad oil, is high in unsaturated fatty acids, protein, and minerals. Sesame oil has been found in studies to slow the growth of colon cancer, reduce blood pressure, and boost antioxidant levels. Sesame seeds also contain mammalian lignan precursors, which may help prevent hormone-related disorders such as breast cancer.[50]

3.4 Nutritional and Therapeutic Potential of Sesame Seeds

Sesame (*Sesamum indicum L.)* is a whimsical harvest that gives various advantages because of its remarkable bioactive parts, for example, sesamin, sesaminol, and gamma-tocopherol, as well as its unsaturated fat structure, which incorporates unsaturated fats (oleic corrosive, linoleic corrosive, stearidonic corrosive, palmitoleic corrosive, and follow measures of linolenic corrosive). Enhancing with sesame seed oil upgrades the nature of tidbit searing oils and adds to better nibble things. Besides, its seeds and oil serve a significant part in the creation of prescriptions used to treat different diseases.[51]

3.5 Dietary Fiber Characteristics and Antioxidant Activity of Sesame Seed Coats (Testae)

The dietary fiber in sesame seed coats, side-effects of dehulling processes, was assessed utilizing the AOAC technique and enzymatic-substance strategy. The AOAC technique showed altogether higher aggregate, insoluble, and dissolvable fiber contents than the enzymatic-compound strategy. The fiber contained high measures of nonpartisan sugars, insoluble uronic acids, and lignin. Actual properties showed a positive connection between's seed coat molecule size decrease, water holding limit, and oil holding limit, yet a negative relationship with mass thickness. Sesame seed coats showed high polyphenol content, and fluid concentrates showed higher cell reinforcement movement than water separates.[52]

3.6 Antioxidant, phytochemical and physicochemical properties of sesame seed (*Sesamum indicum L*)

This article aims to investigate the antioxidant, phytochemical, and physicochemical properties of sesame seeds, an essential oilseed crop grown in Ghana. Sesame seeds have been found to provide health benefits, including protection of the liver from oxidative damage, natural antibacterial effects against common skin pathogens, anti-fungal, anti-viral, and anti-inflammatory effects. Previous studies have shown that sesame seeds contain flavonoids and phenolic compounds that can act as antioxidants.[53]

3.7 Studies on functional and antioxidant property of dietary fiber extracted from defatted sesame husk, rice bran and flaxseed

The review investigates the utilization of defatted oil-bearing materials like sesame husk, rice grain, and flaxseed as useful food fixings. These materials contain dietary fiber, which can help forestall or ease illnesses like cardiovascular infection, diabetes, diverticulosis, and colon malignant growth. The synthesis of these materials reveals that they contain 68%, 27%, and 39% dietary fiber, respectively, which have positive wellbeing impacts like diuretic and cholesterol-lowering specialists. The concentrate additionally analyzed the viability of these dietary fiber arrangements as practical fixings with potential cell reinforcement movement. The outcomes showed that defatted flaxseed and rice grain had higher water-restricting, oil-restricting, and

emulsifying limits compared with sesame husk dietary fiber. Nonetheless, rice grain fiber showed higher cancer prevention agent action than flaxseed and sesame husk.[54]

3.8 Nutritional, Medicinal and Industrial Uses of Sesame (*Sesamum indicum L.)* Seeds - An Overview

Sesame seeds, a high-protein source, have been used in a variety of applications since antiquity. They are used for oil production and have a variety of non-food uses such as cleanser, beauty care products, greases, and medications. Sesame seeds include sesamin and sesamolin, which lower cholesterol in humans and prevent hypertension. The oil has therapeutic and pharmaceutical uses due to its purgative, emollient, and demulcent properties. It also has antibacterial activity against Staphylococcus, Streptococcus, and typical skin growths. Refined sesame oil has a lot of cell reinforcement components, which extends the usefulness and taste of foods. It includes linoleate in the fatty substance composition, which especially inhibits the development of melanoma. The production of biodiesel from sesame seed oil is also being researched for improved usage.[46]

3.9 Antihyperlipidemic Effects of *Sesamum indicum* L. in Rabbits Fed a High-Fat Diet

The study looked at sesame's anti-hyperlipidemic properties in a high-fat fed rabbit model. For 60 days, animals were split into four groups: normal, hypercholesterolemic diet (1% cholesterol), hypercholesterolemic diet (1% cholesterol) + sesame seed (10%), and hypercholesterolemic diet (1% cholesterol) + sesame oil (5%). Serum concentrations of total cholesterol, LDL-C, HDL-C, triglycerides, apoA and apoB, SGOT, SGPT, glucose, and insulin were determined. Hypercholesterolemic diets caused substantial increases in TC, TG, LDL-C, HDL-C, SGOT, and SGPT. Sesame oil supplementation reduced circulation concentrations of TC, LDL-C, HDL-C, SGOT, and SGPT, whereas TG, apoA, apoB, insulin, and glucose levels remained constant.
[55]

3.10 Therapeutic Effectiveness of Sesame Preparations and its Bioactive Ingredients in Management of Cardiometabolic Syndrome in Diabetes Mellitus: A Systematic Review

This review looks into the effects of sesame oil and its bioactive lignans on managing the cardiometabolic conditions Diabetes mellitus (DM) and metabolic disorder (MetS). The study discovered that sesame oil and its lignans had various antihyperglycemic, antilipidemic, relaxing, antioxidative, antihypertensive, cardioprotective, and hepatoprotective effects in two T2DM patients and exploratory animal models. The use of sesame oil as an adjuvant can improve vascular reactivity, aortic porousness, regeneration boundaries, diabetic nephropathy, and anthropometry records. The optimal measurement for further establishing risk biomarkers in patients with T2DM and MetS is 30-35 ml per day, or up to 30% of total energy which generally revolces around 8-12 weeks.[56]

3.11 Investigation of the Hepatoprotective Effects of Sesame (*Sesamum indicum* L.) in Carbon Tetrachloride-Induced Liver Toxicity

Sesame, another option or folkloric treatment, was examined for its hepatoprotective impact in CCl4-prompted exploratory liver harm. Rodents were given 0.8 mg/kg of sesame fixed oil intraperitoneally, and tissue and blood tests were assessed. Results showed swelling degenerations, expanded lipid drops in liver parenchyma, and expanded serum alanine transaminase, aspartate transaminase, and bilirubin in the CCl4 bunch. Sesame fixed oil treatment didn't show a critical hepatoprotective impact in CCl4-prompted liver harmfulness.[57]

3.12 Hepatoprotective Effect of Sesame Oil against Lead Induced Liver Damage in Albino Mice: Histological and Biochemical Studies

This study researched the possible hepatoprotective job of sesame oil against lead acetic acid derivation prompted hepatotoxicity in pale skinned person mice. The liver plays essential capabilities in taking out poisons and unsafe substances from the body. Hepatotoxic specialists can respond with the essential cell parts, causing liver sores. The test consists of 32 grown-up male pale skinned person mice isolated into four gatherings: control, sesame oil bunch, exploratory gathering, and co-regulated bunch. Results showed extreme primary harm in the liver in lead-treated creatures, with unpredictably organized hepatocytes, enlarged focal veins, central degenerative and necrotic changes, and expanded liver weight. Sesame seed oil was able to show viable hepatoprotective activity against lead acetic acid derivation prompted hepatotoxicity in pale skinned person mice, and it was prescribed for populaces of high gamble to take sesame oil.[58]

3.13 Preventive effect of sesame seed cake on hyperglycemia and obesity against high fructose-diet induced Type 2 diabetes in rats

This study investigates the antiobesity impact of sesame seed cake (SSC) on rodents took care of a high fructose diet (HFD). The investigation discovered that SSC decreased weight gain, standardized blood glucose levels, diminished serum cholesterol, and further developed glucose resistance. The oral glucose resistance test showed that rodents took care of with 2% and 4% SSC essentially decreased plasma glucose following 120 minutes of glucose stacking, recommending SSC supplementation as an expected restorative methodology for heftiness instigated Type 2 hyperglycemia.[59]

3.14 Consumption of sesame seeds and sesame products has favorable effects on blood glucose levels but not on insulin resistance: A systematic review and meta-analysis of controlled clinical trials

This study explores the antiobesity effect of sesame seed cake (SSC) on rats fed a high fructose diet (HFD). The study found that SSC reduced weight gain, normalized blood glucose levels, reduced serum cholesterol, and improved glucose tolerance. The oral glucose tolerance test showed that rats fed with 2% and 4% SSC significantly reduced plasma glucose after 120 minutes

of glucose loading, suggesting SSC supplementation as a potential therapeutic strategy for obesity-induced Type 2 hyperglycemia.[60]

3.15 Traditional and medicinal uses of banana

Banana plant has different restorative applications, including blossoms for bronchitis, sap for mania, and leaves for skin burdens. Its remains are utilized for looseness of the bowels and the runs, and roots are utilized for stomach related messes. Banana strip and mash contain antifungal and anti-microbial standards, acting against Mycobacteria and growth infections. The plant additionally contains norepinephrine, dopamine, and serotonin.[38]

3.16 The Effect of Banana Fiber and Banana Peel Fiber on the Chemical and Rheological Properties of Synbiotic Yogurt Made from Camel Milk

Practical food varieties, like yogurt, are pivotal for human wellbeing and sickness counteraction. Yogurt, a matured dairy item, is wealthy in dietary fiber from natural product strips. This study explored the impacts of banana fiber and banana strip fiber on the compound and rheological properties of synbiotic yogurt produced using camel milk. Results showed that rising the fiber content altogether diminished pH, hydration, surface pressure, in general worthiness, variety, and flavor, yet expanded thickness, endurance of probiotic microorganisms, and surface acknowledgment. These strands decreased syneresis, a significant detriment of yogurt, and further developed wellbeing.[61]

3.17 Banana Peels as Potential Prebiotic and Functional Ingredient

The review article explains us about the the prebiotic capability of banana strips on probiotic development in vitro and their utilization as a practical fixing in roll planning. Dessert banana and plantain strips were broiler dried and homogenized, and different development media were made with Banana Strip Powder (BPP), Plantain Strip Powder (PPP), glucose, and inulin. The development execution was gotten to following 24 hours of hatching. BPP and PPP were integrated into rolls, with wheat flour subbed with 10%, 20%, and 30% of BPP and PPP, separately. The supplementation further developed the probiotic microscopic organisms' development rate and age time, with low pH showing extraordinary metabolic action. The expansion of BPP and PPP didn't essentially influence the roll's actual properties, and lower eGI was noticed. Further examination is expected to investigate other prebiotic properties of banana strips and purchaser acknowledgment of banana strip consolidated food varieties.[62]

3.18 Study of prebiotic properties of selected banana species in Thailand

The study explored the potential prebiotic effects of powders from Saba, Pisang Awak Banana, and Silver bluggoe in MRS broth. These plants, known for their water-/oil-binding properties and resistance to stomach and small-intestine enzymes, were used to evaluate their prebiotic properties. The growth of four strains of probiotic bacteria was promoted in MRS broth containing these

plants, but no significant differences were detected in the number of probiotic bacterial groups. The antimicrobial activity of these plants supported probiotic substance production to inhibit pathogenic bacteria growth. The addition of these plants as a prebiotic food ingredient represents a potential alternative to commercial prebiotics.[63]

3.19 Prospects of microbial cellulase production using banana peels wastes for antimicrobial applications

This article explains about the potential of banana peels as antimicrobial agent. Microorganisms are broadly utilized for delivering proteins and bioactive substances, including cellulases, which are fundamental for modern applications. Minimal expense creation frequently faces difficulties because of the absence of modest substrates. Cellulosic squanders, for example, banana strips, are a reasonable bioresource for minimal expense and proficient cellulase protein creation. Banana strips are a sustainable, high-cellulose, and sugar-containing food squander that can be utilized as a substrate for cellulase catalyst creation. This survey investigates the capability of banana strips as a food squander for microbial cellulase creation and their applications as antimicrobial specialists. The survey gives likely limits and future ideas for cellulase protein creation and their expected applications in biomedical applications.[64]

3.20 Development of cellulose-based prebiotic fiber from banana peel by enzymatic hydrolysis

The review broke down the prebiotic movement of to some degree hydrolyzed cellulose from banana strips, got from enzymatic and weakened corrosive hydrolysis. The outcomes showed that enzymatic hydrolysis by Celluclast® gave higher water-solvent cellulose and cellodextrins than weakened corrosive hydrolysis. Cellobiose and cellotriose essentially upheld the development and lactic corrosive creation of probiotic strains. The cellulose was put away in two structures: arrangement and dried powder. In any case, the dried powder couldn't be utilized as a sole carbon source by the microorganisms because of decreased solvency. The cellulose arrangement advanced the development of L. plantarum TISTR2075 however didn't uphold E. coli TISTR073, demonstrating a positive prebiotic record esteem higher than inulin, an economically known prebiotic fiber.[65]

3.21 Extraction and characterization of phenolic compounds and dietary fibers from banana peel

The phenolic extract from banana strip was removed utilizing 95% ethanol and portrayed utilizing LC-TOF-MS/MS. The concentrate contained different mixtures, for example, epicatechin, rutin, and chlorogenic corrosive. Cholate tests were directed to look at the hypolipidemic impact of the dietary strands. The strands ready with sulphuric corrosive, sodium hydroxide, and trypsin treatment showed high water-holding limits and enlarging limits. They likewise had high oil-holding limits and upgraded sodium cholate adsorption limits. The outcomes propose banana strip as an expected practical fixing in food applications.[66]

3.22 Antihyperglycemic and Hypolipidemic Potential of *Kepok* Banana Peel in Diabetic Rats

Diabetes mellitus (DM) can damage blood vessels, leading to heart attack, stroke, kidney problems, and increased LDL cholesterol levels. This study tested the effectiveness of kapok banana peel extract in reducing glucose, triglyceride, and LDL cholesterol levels in streptozotocine-induced Rattus norvegicus. The 21-day experimental design involved 25 male rats, and data analysis using Wilcoxon, Kruskal Wallis, and Mann Whitney tests. Results showed that banana peel extract reduced glucose, triglycerides, and LDL cholesterol levels, suggesting its potential as an antihyperglycemic and antilipidemic agent in diabetic rats.[67]

3.23 HYPOGLYCEMIC EFFECT OF BANANA PEEL EXTRACT (MUSA PARADISIACA VAR KEPOK) IN NEW ZEALAND WHITE RABBITS WITH DIABETES HYPERLIPIDEMIA

This study investigates the potential of banana peel extract Musa Paradisiaca var. kepok (MPvK) in reducing blood sugar levels in New Zealand White rabbits with diabetes hyperlipidemia. The study involved 27 male rabbits aged 4 months and 1.5-2 kg, and was conducted at LPPT unit 4 UGM. Results showed significant differences in blood sugar levels in group 1 (O1), group 2 (O2), and group 3 (O3) at least two measurement times. The ethanol extract of MPvK peels had a hypoglycemia effect on the rabbits, with significant differences in blood sugar levels in each group and at each measurement time. The study suggests that waste processing banana peels could be a more beneficial product for health.[68]

3.24 EFFECT OF BANANA (Musa Balbisiana) FRUITS AND ITS PEELS ON ACUTE HEPATOTOXICITY WITH DIABETIC RATS

The review examined the effect of banana foods grown from the ground strips on intense hepatotoxicity in diabetic rodents. The rodents were partitioned into six gatherings, with the benchmark group being taken care of a basal eating regimen. The rodents were then infused with Streptozotocin and randomized into five gatherings: diabetic rodents, those took care of a basal eating regimen enhanced with dried banana natural product, and diabetic rodents took care of a basal eating regimen enhanced with dried banana organic product strips. The rodents were then subcutaneously infused with carbon tetrachloride two times toward the finish of the trial time frame. The outcomes showed that the basal eating routine enhanced with dried banana natural product or strips altogether diminished serum glucose levels and expanded high thickness lipoprotein and insulin action levels contrasted with the control diabetic rodents.[69]

In those above research articles, they have tried to establish the potential of banana peel and Sesame seed in the action of hepatotoxicity, hyperglycemia, and hyperlipidemia. From those above research articles, we can safely assume that both the banana peel and the sesame seed have anti hyperlipidemic, antihyperglycemic and hepatoprotective activities. But most of the activities were established or tested for other ingredients of those sesame seed and banana peel. So, there is a huge

gap of understanding about the potential of dietary soluble and insoluble fibers extracted from those two samples in those activities. So, in my research article, I will try to establish that the soluble dietary fiber and insoluble dietary fiber extracted from those Samples can treat those above activities.

Moreover, we have understood from those above Research articles that, those two samples, which are banana peel and the black sesame seed, have Potential separately. on those Activities. But there is no established research or tests about the joint or synbiotic activities of black sesame seed and ripe banana peel. I believe in the research article I can try to establish the potential of dietary soluble fibers are insoluble fibers extracted from those samples As Well as The potential of those fibers when they are given jointly or by synbiotic system in the mice.

Chapter-4
Study Purpose

4.1 Purpose of the study

In this investigation, we are examining how eating fiber-rich foods and yogurt affects our levels of cholesterol, triglycerides, and glucose. Diets heavy in fat can increase body fat and damage organs. Steady hyperglycemia can cause kidney hurt, eye hurt close to diabetes, cardiovascular disease can cause coronary episode Congestive cardiovascular breakdown, and so on. Also, hepatic brokenness can cause ordinary capacity peculiarities like ailment, stomach torture, jaundice, etc. This assessment was finished to conclude the impact of fiber containing normal sources as prescriptions on the cardiovascular structure, liver capacity and glucose ability using Lipid profile, SGPT and OGTT biochemical limit assessments.

Dried fruit's peel of *Musa ornata* act as a source of soluble dietary fiber in this investigation. They have antioxidant, antifungal and wound healing properties of the body. Other than dietary fibers, they have Gathered units fairly compounds that can be act as an allopathic medicine. They can also be used as a prebiotic source. This study looked at the lipid-profile-lowering and hepatoprotective properties of ripe banana peel as soluble fiber.[36][35]

Sesamum indicum acts as a source of insoluble dietary fiber in this investigation. Sesame seeds are a decent wellspring of solid fats, especially polyunsaturated fats like linoleic corrosive. These fats can assist with bringing down LDL (terrible) cholesterol levels and raise HDL (great) cholesterol levels, diminishing the gamble of coronary illness, stroke, and cardiovascular failure. Sesame seeds have been displayed to make hepatoprotective impacts, meaning they can assist with safeguarding the liver from harm. This is reasonable because of their cancer prevention agent and calming properties. Sesame seeds are likewise a decent wellspring of protein, which is fundamental for liver wellbeing. Protein helps fix and recover liver cells. As well as sesame seeds and sesame plants have phytochemicals, including lignans, phenolic acids, flavonoids, saponins, and alkaloids that have recuperating properties in body.[48][46]

There is a typical acceptance that normal enhancements are more secure because they are gotten from regular sources, like spices, plants, or minerals, contrasted with conventional prescriptions which frequently contain manufactured compounds. Regular enhancements are frequently seen to have fewer secondary effects contrasted with conventional drugs, which can now and then accompany a significant rundown of possible unfriendly impacts. Certain individuals favor an all-encompassing way to deal with wellbeing, zeroing in on regular cures that address actual side effects as well as mental and close to home prosperity.[62]

In many societies and civilizations normal cures have been utilized for ages and are profoundly imbued in conventional practices and convictions. Regular enhancements are seen as a method for enhancing the eating regimen with supplements that might be missing from current, handled food varieties.[70]

- To find out the cardiovascular activity, hepatoprotective benefit, and antidiabetic benefit of those sample fiber source
- To establish natural fiber containing sources as alternative medicines.
- To establish that natural supplements like synbiotic foods have fewer side effects and safer use than normal traditional medicine since most of them have synthetic compounds.

Chapter-5
Methods and Materials

5.1 Plant Collection & Identification

Normally in our country *Musa ornata* (Banana) is found very easily because our environment is friendly for them to grow healthy. So, Musa ornata's ripe fruit was very easy to find and was collected from a local vendor who is known for selling best banana fruit without mixing any adulteration. After that, those bananas were peeled properly and those peeled skin were taken into a separate dish.

Sesamum indicum seeds (sesame seeds) are basically collected when they are dry. They were collected from the Botanical Garden, Dhaka, Bangladesh as sealed material. Both the sample products were collected in January 2024 during the daytime.

During collection, any adulteration with those samples were strongly avoided. Later it was authenticated at the Bangladesh National Herbarium, Mirpur, Dhaka, Bangladesh for further use in our test parameters.

5.2 Materials Drying & Grinding

After collecting the plants/seeds, first thing was to sort out unwanted substances visually. Sometimes there can be unwanted things like other part of the plants, soil, sand or small pebbles which should be removed properly by visual inspection.

Then the banana peel and sesame seeds were dried at room temperature (30 ± 3°C) for 20 days or dried under the sun for 1 week, ensuring that the active constituents were not decomposed. For removing the moisture, papers can be used to act as a base for drying those components.

After drying, they were converted into fine powders by using a local grinder. After that, the powder was stored in an airtight container and placed in a dark, cool, and dry place. Throughout the process it should e ensured that clean equipment and a contaminant-free environment to avoid contamination of the sample.

5.3 Suspension for the sample

After preparation of the powder, sesame seeds for the source of insoluble dietary fibre and ripe banana peel as a source of soluble dietary fibre were mixed with yogurt and a small portion of water to form the suspension.

Amount of sample

- Daily Dietary fiber intake for adult is about 30 gm[11]
- For animal dose calculation in clinical research, Human dose(mg/kg) * (human k_m /animal k_m) formula is used.[72]
- For determination of k_m value, (body weight in kg/surface area) formula is used.
- And for human k_m determined value is 37.[72]

- And by this formula, intake of ripe banana peel is 0.43 gm and sesame seed is 0.25 gm (per mice) daily with some water and yogurt.

5.4 Experimental design

For this investigation, Wistar albino mice (32-36 gm) were recruited from the Jahangirnagar University Lab.

The mice were then brought to the Daffodil International University pharmacology lab (and housed under suitable environmental conditions (22-25°C, 60-70% humidity, 12 hr. dark cycle, and 12 hr. light).

Each mouse eats 16-20g of food daily. Prior to the experiment, the mice spent 3 days in colony cages in the department's temperature-controlled (25–30 °C) animal room. The bedding was changed daily to maintain hygienic conditions.

5.5 Mice Grouping

Animals were classified into 3 groups, and each group consists of 3 mice. The groups are: control group, standard group, and fiber combination (Ripe banana peel + Sesame seed + Yogurt)

Experimental Procedure

- All the groups were named as (peel + seeds + yoghurt), standard and Control.
- All the mice of one group were placed in a rat case.
- A bowl was attached in every case to feed the rat.
- Animal feeds were collected from the market and crushed into course powder through a blender.
- For (peel + seeds + yoghurt) group, the feed is prepared properly with proper amount of peel, seed, powder with yoghurt and water. (see Feeding Procedure 1)
- For (standard)group; only feed is prepared with Carlyle capsule. (see Feeding Procedure 2)
- For (control) group; only feed is prepared thoroughly. (see Feeding Procedure 3)

5.6 Medication

Medication for the study

Group	Medication
Control(Distilled water)	Normal Food
Standard(Carlyle capsule)	0.06g/kg
Group (Fiber Combination)	[Peel 1.29 gm + Seed .75 gm +Yogurt] (Per 3 mice)

The treatment was given to the mice for 14 days.

5.7 Feeding Procedure 1

For (peel + seeds + yogurt) group

- All the ingredients were mixed with proper value of Peel 1.29 gm + Seed .75 gm (Per 3 mice) and a small quantity of yogurt, respectively.
- Mixed by adding 6 ml of water (quantity sufficient).
- Then it was given to the mice.
- Water was given through a mouse water bottle.

5.8 Feeding Procedure 2

For Standard Group

- This experiment was performed by using 0.06 g/kg of Carlyle capsule as standard with 2 ml of water for each mouse.
- Then it was given to the mice with the help of a feed needle through the oral route of administration.

5.9 Feeding Procedure 3

For Control Group

- 20 g of feed was weighted via a balance.

- 10 ml of water was weighted and mixed with the feed.
- Later, it was given to the mice.
- Water was given through a mouse water bottle.

5.10 Waste Calculation

- The feeds remaining in the bowl was weighted properly and daily.
- Then the amount of food intake is calculated through the following process-
- Food intake = Weight of given food - Weight of remaining food

5.11 Body Weight Comparison

- The body weight of each rat was taken daily before giving it food.
- Later, the body weight of each mouse was compared with the initial body weight.

5.11 Blood collection

The experimental drugs and samples were successfully administered to the mice for 14 days before they were killed, and blood samples were taken on the 7th and 14th days. A sample of 2-3 ml blood was taken using the cardiac puncture technique. The serum was then taken from the blood and kept for later research by centrifuging it (4000 rpm, 15 min).

5.12 Biochemical test

Three biochemical tests were performed as part of the inquiry. The SGPT is the first, while the lipid profile is the second. The lipid profile included measurements of triglycerides, HDL, and LDL levels in addition to total cholesterol. On a Backman Coulter AU-480 (model) device, spectrophotometer was used for both tests.

5.13. Hypolipidemic Activity Test

Cholesterol is present within all animal body specifically on membrane, blood stream etc. It is generally a fatty substance and alcoholic in nature. It plays a vital role for maintaining cell fluidity and permeability. Triglyceride (TG) are chains of fatty acids which provide energy for proper functioning of cells. On the other hand, elevated HDL are harmful causing pancreatitis, atherosclerosis, coronary heart diseases are usually produced. HDL also reduces LDL cholesterol. So, HDL is known as good cholesterol and vice versa.

Chapter-6
RESULTS AND DISCUSSION

6.1 Weight calculation of experimental mice

Group	Medication and Fiber combination		Final Weight (gm)	Weight Variation (gm)
Control (Distilled water)	Normal Food	28. ± 1.52	28.66 ± 1	0.66 gm (Increased)
Standard (Carlyle capsule)	Carlyle (0.06 g/kg)	34.66 ± 2.51	35 ± 3	0.34 gm (Increased)
Group (Fiber combination)	(Peel + Seed + Yogurt)	33.7 ± 1.5	35 ± 1	1.3 gm (Increased)

Table 6.1: Weight variation determination after finishing the study

Data were expressed as mean ± SEM (Standard Error Mean), where n = 3 for each group.

This table shows the experimental animals' initial and final weights, as well as how they changed over time due to daily feeding and take care. The weight gain after the trial was 0.66 grams in the control group, which can be mentioned as very little change. Contrarily, it was startlingly found that there was a 0.34 gm weight variation in the Standard group while the Sample group's weight was increased by 1.3 grams.

The control group's weight fluctuation did not alter much throughout the trial since they maintained a regular, nutritious diet and they were not given any of the sample or any of the standard synbiotics as only normal feed was given.

6.2 Biochemical test result

6.2.1 Activity of SGPT level

Group	Medication	SGPT level (IU/L)	Normal Range of SGPT level
Control	Normal Food	40.33 ± 1.76	**10-40 IU/L**
Standard	Carlyle (0.06g/kg) orally	39.35 ± 2.75	
Group (Fiber Combination)	(Peel + Seed + Yogurt)	34.07 ± 5.9	

Table 6.2.1: Effects of Fiber Combination on SGPT level

Data were expressed as mean ± SEM (Standard Error Mean), where n = 3 for each group.

This table displays the levels of serum glutamic pyruvic transaminase (SGPT) also known as Alanine Aminotransferase (ALT) in the control and sample groups, as well as the permitted limits for mice. The SGPT (ALT) levels of the control and sample groups, with values of 40.33 ± 1.76 (UI/L) and 37 ± 4.04 (UL/L), respectively, are normal because the typical range is between 10 and 40 (IU/L). The SGPT (ALT) level of sample group is about 34.07 ± 5.9 (UI/L). SGPT is involved in the conversion of the amino acid alanine to pyruvate and vice versa. This process is part of the body's mechanism for producing energy and maintaining proper levels of amino acids as well as participates in various metabolic functions.

Monitoring SGPT levels in the blood can provide valuable information about liver health, as elevated levels may indicate liver damage or disease. So, our sample group’s SGPT level under the normal limit indicates that it has a positive effect on the mice body and the sample can positively on the protein and maintain glucose levels in body.

6.2.2 Activity of OGTT level

Group	Medication	Glucose level (mmol/L) Fasting	Normal Glucose level (mmol/L) (Fasting)	Oral Glucose Tolerance Test after 2 hours(mmol/L)	Normal Range of OGTT level
Control (Distilled water)	Normal Food	5.91	4-6 mmol/L	7.65	7-9 mmol/L
Standard	Carlyle (0.06g/kg) orally	5.4		6.1	
Group (Fiber Combination)	(Peel + Seed + Yogurt)	4.47		6.32	

Table 6.2.2: Effects of Fiber Combination on OGTT level

This table displays the levels of oral glucose tolerance test (OGTT) in the control and sample groups, as well as the permitted limits for mice. The glucose levels fasting in the control and sample groups, with values of 5.91 mmol/L and 4.47 mmol/L, respectively, are quite different. Normal Glucose level in the body during fasting should be 4-6/4-7 mmol/L and the control group's glucose level which was absent of sample fiber or standard drug had a glucose level is within the range. But the glucose level of sample group was under 5 mmol/L which indicates the positive effect of glucose level reduction in the body by those sample.

But the sample After 2 hours, using glucose as the tolerance level, the control and sample group values are 7.65 mmol/L and 6.32 mmol/L against the standard value. That indicates the efficiency of sample in reducing glucose level which is increased in a short time and the standard has shown a lesser activity on glucose tolerance.

6.2.3 Activity on Lipid profile

Group	Medication	Total cholesterol (mg/dl)	Triglyceride (mg/dl)	HDL (mg/dl)	LDL (mg/dl)
Normal Value	-	80-130	50-150	30-80	20-80

Control (Distilled water)	Normal Food	68.67 ± 2.20	124.07 ± 2.94	49.14 ± 1.05	54.11 ± 1.15
Standard	Carlyle (0.06 g/kg) orally	42 ± 9.92	47.7 ± 10.35	41 ± 5.70	26.8 ± 3.70
Group (Fiber Combination)	(Peel + Seed + Yogurt)	59.81 ± 2.73	53.91 ± 4.37	35.08 ± 1.86	43.90 ± 1.48

Table 6.2.3: Effects of Fiber combination on Lipid profile

Normal Range was Collected from research article.[73]

Data were expressed as mean ± SEM (Standard Error Mean), where n= 3 for each group.

The fiber combination group's total cholesterol level was 59.81 ± 2.73 mg/dl while the control group's was 68.67 mg/dl. As a result, it is assumed that sample treatment caused a drop of 8.86 mg/dL in the total cholesterol level. That means sample has the power of reducing the risk of cardiovascular disease.

Also, the total cholesterol level in the standard group was about 42 mg/dl which indicates that the standard drug has a better efficiency in reducing total cholesterol level than sample fibers.

The sample's triglyceride level was 53.91 ± 4.37 mg/dl compared to the control's 124.07 mg/dl, a decreased amount of 70.16 mg/dl decrease which is a significant difference between the two results so the amount and that indicates that the sample fibers have a very positive effects in reducing the triglyceride levels into optimum level because normal level revolves around 50-150 mg/dl.

The problem with the HDL value was that it was lower in the sample group than in the control group, with values of 35.08 ± 1.86 mg/dl (sample group). HDL acts like a scavenger, picking up excess cholesterol throughout our body, including from our arteries as well as they transport the extra cholesterol back to liver so if the HDL value is lower in the sample group than control group, the fibers have neutral to negative activity on HDL level increasing.

The LDL level in the control group and in the sample group are respectively 54.11 ± 1.15 mg/dl and 43.90 ± 1.48 mg/dl which indicates 2 things.

Both groups LDL level is in the desired range of mice and there is a reduction of LDL level in sample group which indicates a positive effect of fibers in those mice because those LDL carry cholesterol from liver to the circulation and higher the amount of LDL in circulation, higher the chance of different disease like cardiovascular problems.

On the other hand, the value of lipid profile for the standard group was TG 47.7 ± 10.35, HDL 41 ± 5.70, and LDL 26.8 ± 3.70.

Chapter-7
CONCLUSION

7.1 Conclusion

Cardiovascular illness, hepatic brokenness, and ongoing hyperglycemia are persistent problems that need numerous medication treatments to control the sickness. What is more, these prescriptions affect various pieces of our body. Persistent hyperglycemia can cause kidney harm, eye harm alongside diabetes, cardiovascular infection can cause coronary episode Congestive cardiovascular breakdown, etc. Additionally, hepatic brokenness can cause typical capability anomalies like sickness, stomach torment, jaundice, and so on. This examination was completed to decide the effect of fiber containing regular sources as meds on the cardiovascular framework, liver capability and glucose capability utilizing Lipid profile, SGPT and OGTT biochemical boundary examinations.

There were slight variations in SGPT levels compared to the control (40.33 ± 1.76 IU/L) where the values for the fiber combination were (34.07 ± 5.9 IU/L.). A fiber combination (Peel + Seed + Yogurt) of [Peel 1.29 gm + Seed .75 gm +Yogurt] (Per 3 mice) was used throughout the total experiments. However, it significantly affects lipid profiles and aims to keep them within an acceptable range. The lipid profiles for control groups were (total cholesterol 68.67 ± 2.20 mg/ dl, triglycerides 124.07 ± 2.94 mg/dl, HDL 49.14 ± 1.05 mg/ dl, LDL 54.11 ± 1.15 mg/dl) respectively, while the fiber combination groups were (59.81 ± 2.73 mg/dl, 53.91 ± 4.37 mg /dl, 35.08 ± 1.86 mg/dl, 43.90 ± 1.48 mg/dl) sequentially which strongly indicates that the sample (fiber) group was successful in lowering most of the aspects of lipid profiles (with an exception of HDL level where the sample groups level should be higher than control group) significantly.

Moreover, the effect on OGTT level for the control group was 7.65 mmol/L whereas the fiber combination group was 6.32 mmol/L which represents the fiber containing foods have positive capability to control the diabetic conditions.

A promising defensive outcome against cardiovascular and hepatic problems was tracked down by the organization of a fiber blend. To mention these observable facts more substantial, further examination ought to be finished.

Chapter-8
Reference

8.1 Reference

1) Ajay Mili, S. D. (2021). A comprehensive review on Sesamum indicum L.: Botanical, ethnopharmacological, phytochemical, and pharmacological aspects. *Journal of Ethnopharmacology, 281*, 114503.

2) Aline Pereira, M. M. (2015). Banana (Musa spp) from peel to pulp: ethnopharmacology, source of bioactive compounds and its relevance for human health. *Journal of Ethnopharmacology , 160*, 149-163.

3) Alireza Yargholi, M. H. (2021). The Effects of Sesame Consumption on Glycemic Control in Adults: A Systematic Review and Meta-Analysis of Randomized Cl. *Evid Based Complement Alternat Med*, 1-11.

4) Amin F. Majdalawieh, M. M. (2017). A comprehensive review on the anti-cancer properties and mechanisms of action of sesamin, a lignan in sesame seeds (Sesamum indicum). *European Journal of Pharmacology, 815*, 512-521.

5) Amita Pandey, S. T. (2014). Concept of standardization, extraction and pre phytochemical screening strategies for herbal drug. *Journal of Pharmacognosy and Phytochemistry, 2*(5), 115-119.

6) Anilakumar, K. R. (2010). Nutritional, medicinal and industrial uses of sesame (Sesamum indicum L.) seeds-an overview. *Agriculturae Conspectus Scientificus, 75*(4), 159-168.

7) Asgary, S. R.-K. (2013). Antihyperlipidemic effects of Sesamum indicum L. in rabbits fed a high-fat diet. *The Scientific World Journal* .

8) Azab, A. E. (2014). 3.16. Hepatoprotective Effect of Sesame Oil against Lead Induced Liver Damage in Albino Mice: Histological and Biochemical Studies. *American Journal of BioScience, 9*(1), 1-11.

9) Ballantyne CM, G. S. (2000). Hyperlipidemia: diagnostic and therapeutic perspectives. *J Clin Endocrinol Metab, 85*(6), 2089-2112.

10) Bent, S. (2008). Herbal medicine in the United States: review of efficacy, safety, and regulation: grand rounds at University of California, San Francisco Medical Center. *Journal of general internal medicine*, 854-859.

11) Bhushan Patwardhan PhD, G. M. (2015). *Integrative Approaches for Health: Biomedical Research, Ayurveda and Yoga.*

12) Bhushan Patwardhan, G. T. (2015). Evolution of Medicine. In *Integrative Approaches for Health: Biomedical Research, Ayurveda and Yoga* (pp. 27-52). Academic Press.

13) Bigoniya, P. N. (2012). 3.17. Preventive effect of sesame seed cake on hyperglycemia and obesity against high fructose-diet induced Type 2 diabetes in rats. *Food Chemistry, 133*(4), 1355-1361.

14) Cengiz, N. K. (2013). 3.15. Investigation of the Hepatoprotective Effects of Sesame (Sesamum indicum L.) in Carbon Tetrachloride-Induced Liver Toxicity. *The Journal of Membrane Biology, 246*, 1-6.

15) Chee Yee Tan, N. N. (2024). Banana Peels as Potential Prebiotic and Functional Ingredient. *Indonesian Journal of Nutrition and Food, 19*.

16) Das, R. M.-G. (2021). Medicinal plants used against hepatic disorders in Bangladesh: A comprehensive review. *Journal of Ethnopharmacology, 1*, 1-115.

17) Department of Abilities – Humanistic Sciences, Iuliu Hatieganu University of Medicine and Pharmacy. (2017). History of Medicine between tradition and modernity. *Clujul Medical, 90*(2), 243-245.

18) Dimitrios Papandreou, Z. T. (2015). The Role of Soluble, Insoluble Fibers and Their Bioactive Compounds in Cancer: A Mini Review. *Food and Nutrition Sciences , 6*(1), 1-11.

19) Dravie, E. E. (2020). Antioxidant, phytochemical and physicochemical properties of sesame seed (Sesamum indicum L). *Scientific African, 8*.

20) Ekor, M. (2014). The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety. *Frontiers in pharmacology*, 66193.

21) Elayabalan, S. S. (2017). An overview on phytochemical Composition of Banana (Musa spp.). *Int. Bimon. Indian J. Nat. Sci, 7*, 12408-12419.

22) Elleuch, M. B. (2007). Quality characteristics of sesame seeds and by-products. *Food chemistry, 103*(2).

23) Elleuch, M. B. (2012). Dietary Fibre Characteristics and Antioxidant Activity of Sesame Seed Coats (Testae). *International Journal of Food Properties, 15*(1), 25-37.

24) Erhardt, P. (2009). Chapter 19 - Drug Discovery. In *Pharmacology (Principles and Practice)* (pp. 475-560). Academic press .

25) Fakir, M. M. (2015). Biodiversity of Medicinal Plants in Bangladesh: Prospects and Problems of Conservation and Utilization. *International Journal of Minor Fruits, Medicinal and Aromatic Plants, 1*(1), 1-9.

26) Fatemeh Jamshidi-Kia, Z. L.-K. (2018). Medicinal plants: Past history and future perspective. *Journal of Herbmed Pharmacology, 7*(1), 1-7.

27) Fredrickson, D. S. (1971). An international classification of hyperlipidemias and hyperlipoproteinemias. *Annals of Internal Medicine, 75*(3), 471-2.

28) Gianotti L, e. a. (2010). randomized double-blind trial on perioperative administration of probiotics in colorectal cancer patients. . *World journal of gastroenterology: WJG, 16*(2), 167-175.

29) Gillor O., E. A. (2008). The dual role of bacteriocins as anti- and probiotics. *Appl Microbiol Biotechnology, 81*(4), 591-606.

30) Grendell, J. H., McQuaid, K. R., & Friedman, S. L. (2003). Current diagnosis & treatment in gastroenterology. *New York: Lang Medical Books/McGraw-Hill*.

31) Hord, N. G. (2008). Eukaryotic-Microbiota Crosstalk: Potential Mechanisms for Health Benefits of Prebiotics and Probiotics. *Annual Revie of Nutrition , 28*(1), 215-231.

32) Indriawati, R. &. (2022). Antihyperglycemic and Hypolipidemic Potential of Kepok Banana Peel in Diabetic Rats. *In IOP Conference Series: Earth and Environmental Science, 985*.

33) Isita Nandi, M. G. (2015). Studies on functional and antioxidant property of dietary fibre extracted from defatted sesame husk, rice bran and flaxseed. *Bioactive Carbohydrates and Dietary Fibre, 5*(2), 129-136.

34) J., C. M. (2000). Beneficial Effects of High Dietary Fiber Intake in Patients with Type 2 Diabetes Mellitus. *New England Journal of Medicine , 342*(19), 1392-1398.

35) Khan, I. U. (2019). Evaluation of polyphenols, flavonoids and antioxidant activity in different solvent extracts of sesame (Sesamum indicum L.) genotypes. *International Journal of Food Spices, 9*(2), 52-60.

36) Kumar, K. S. (2012). Traditional and medicinal uses of banana. *Journal of pharmacognosy and phytochemistry, 1*(3), 51-63.

37) L., E. C. (2020). Dietary fibre and cardiovascular health: A review of current evidence and policy. *Proceedings of the Nutrition Society , 79*(1), 61-67.

38) Langham, D. R. (2007). *Phenology of Sesame.* Virginia : ASHS Press.

39) Linyan Li, M. P. (2020). Effects of insoluble and soluble fibers isolated from barley on blood glucose, serum lipids, liver function and caecal short-chain fatty acids in type 2 diabetic and normal rats. *Food and Chemical Toxicology, 135*, 110937.

40) Mahmoodi, M. R. (2023). 3.14. Therapeutic Effectiveness of Sesame Preparations and its Bioactive Ingredients in Management of Cardiometabolic Syndrome in Diabetes Mellitus: A Systematic Review. *Current Diabetes Reviews, 19*(3), 79-93.

41) Mandlik, D. a. (2013). Models of hepatotoxicity and the underlying cellular, biochemical and immunological mechanism(s): A critical discussion. *Environmental toxicology and pharmacology, 37*, 118-133.

42) Marcy J. Balunas, A. D. (2005). Drug discovery from medicinal plants. *Life Sciences, 78*(5), 431-441.

43) Mbaebie, B. O. (2010). Chemical composition of Sesamum indicum L.(Sesame) grown in southeastern Nigeria and the physicochemical properties of the seed oil. *Seed science and biotechnology,, 4*(1), 69-72.

44) Mireya Burgos, D. G.-C. (2017). Phylogenetic position of the disjunct species Musa ornata (Musaceae): first approach to understand its distribution. *Genetic Resources and Crop Evolution, 64*(8), 1889-1904.

45) Mohamed Elleuch, D. B. (2011). Chapter 122 - Sesame (Sesamum indicum L.) Seeds in Food, Nutrition, and Health. In D. B. Mohamed Elleuch, *Nuts and Seeds in Health and Disease Prevention* (pp. 1029-1036). Academic Press.

46) Mohammed Rahmatullah, A. R. (2012). Ayurvedic influence on use of medicinal plants in Chakma traditional medicine. *American-Eurasian Journal of Sustainable Agriculture, 6*(2), 107-112.

47) Muhammad Shahzad Aslam, M. S. (2016). Worldwide Importance of Medicinal Plants: Current and Historical Perspectives. *Recent Adv Biol Med, 2*(1), 88-93.

48) N. C. Suares, A. C. (2011). Systematic review: the effects of fibre in the management of chronic idiopathic constipation. *Alimentary Pharmacology & Therapeutics, 33*(8), 895-901.

49) Nanouk G. M. Wiemer, E. M. (2008). The effect of acute hyperglycemia on retinal thickness and ocular refraction in healthy subjects. *Graefe's Archive for Clinical and Experimental Ophthalmology, 246*(5), 703-708.

50) Nirmal, S. &. (2013). *Contribution of Herbal Products in Global Market.* India.

51) Nitin Mehta, M. K. (2019). Development of Dietary Fiber-Rich Meat Products: Technological Advancements and Functional Significance. In *Bioactive Molecule in Foods* (pp. 763-795). Springer, Cham.

52) Nurul Muhlishah, I. S. (2016). THE ANALYSIS of TOTAL CHOLESTEROL LEVELS IN MICE (Mus musculus) MALES WHOWERE GIVEN EXTRACTS of METHANOL LEAF CEMBA (Acacia pennata). *Proceedings of ICMSTEA 2016 : International Conference on Mathematics, Science, Technology, Education*.

53) Ostapowicz, G., Fontana, R. J., Schiødt, F. V., Larson, A., Davern, T. J., Han, S. H., McCashland, T. M., Shakil, A. O., Hay, J. E., Hynan, L., Crippin, J. S., Blei, A. T., Samuel, G., Reisch, J., Lee, W. M., & U.S. Acute Liver Failure Study Group. (2002). Results of a prospective study of acute liver failure at 17 tertiary care centers in the United States. *Annals of Internal Medcine , 137*(12), 947-954.

54) Palit, P. (2018). Chapter 3 - Bioactivity-Guided Phytofractions: An Emerging Natural Drug Discovery Tool for Safe and Effective Disease Management. In *Natural Products and Drug Discovery* (pp. 57-71). Silchar, India.

55) Pandy, V. (2020). A Simple Method for Animal Dose Calculation in Preclinical Research. *EC Pharmacology and Toxicology, 8*, 1-2.

56) Pannapa Powthong, B. J. (2020). Study of prebiotic properties of selected banana species in Thailand. *Journal of Food Science and Technology*, *57*, 2490-2500.

57) Pereira, A. &. (2015). Banana (Musa spp) from peel to pulp: ethnopharmacology, source of bioactive compounds and its relevance for human health. *Journal of ethnopharmacology*, *160*, 149-163.

58) Phirom-on, K. &. (2021). Development of cellulose-based prebiotic fiber from banana peel by enzymatic hydrolysis. *Food Bioscience, 41*.

59) Pothavorn, P. K. (2010). Sap phytochemical compositions of some bananas in Thailand. *ournal of Agricultural and Food Chemistry, 58*(15), 8782-8787.

60) Rajeev Singh, A. A. (2023). Prospects of microbial cellulase production using banana peels wastes for antimicrobial applications. *International Journal of Food Microbiology*, *388*.

61) Rudo F. Mapanga, M. F. (2016). Damaging effects of hyperglycemia on cardiovascular function: spotlight on glucose metabolic pathways. *American Journal of Physiology: Heart and Circulatory Physiology , 310*(2), H153-H173.

62) Sabiha Abbas, M. K.-e.-A. (2022). Nutritional and Therapeutic Potential of Sesame Seeds. *Journal of Food Quality*.

63) Safdari, Y. V. (2021). The effect of banana fiber and banana peel fiber on the chemical and rheological properties of symbiotic yogurt made from camel milk. *International Journal of Food Science*.

64) Samiasih, A. H. (2018). HYPOGLYCEMIC EFFECT OF BANANA PEEL EXTRACT (MUSA PARADISIACA VAR KEPOK) IN NEW ZEALAND WHITE RABBITS WITH DIABETES HYPERLIPIDEMIA. *Health Notions, 2*(11), 1101-1104.

65) Sheikh Rashel Ahmed, Muhammad Fazle Rabbee, Anindita Roy, Rocky Chowdhury, Anik Banik, Khadizatul Kubra, Mohammed Mehadi Hassan Chowdhury, Kwang-Hyun Baek. (2021). Therapeutic Promises of Medicinal Plants in Bangladesh and Their Bioactive Compounds against Ulcers and Inflammatory Diseases. *Plants, 10*, 1-30.

66) Shiyi Ou, K.-c. K. (2001). In Vitro Study of Possible Role of Dietary Fiber in Lowering Postprandial Serum Glucose. *Journal of Agricultural and Food Chemistry, 49*(2), 1026-1029.

67) Shruthi, D. (2019). Medicinal uses of banana (Musa paradisiaca). *Drug invention today, 12*(1).

68) Singh, A. B. (2014). Clinical biochemistry of hepatotoxicity. *Journal Of Clinical Toxicology, 4*(1), 1-19.

69) Siyao Liu, Z. F. (2023). Recent development in fabrication and evaluation of phenolic-dietary fiber composites for potential treatment of colonic diseases. *Critical Reviews in food science and nutrition , 63*(24), 6860-6884.

70) Sohouli, M. H.-R. (2022). 3.18. Consumption of sesame seeds and sesame products has favorable effects on blood glucose levels but not on insulin resistance: A systematic review and meta-analysis of controlled clinical trials. *Phytotherapy Research, 36*(3), 1126-1134.

71) Sulistyaningsih, L. D. (2016). The diversity of wild banana species (Genus Musa) in Java. . *Makara Journal of Science, 20*(1), 6.

72) Surampudi, P. E. (2016). Lipid Lowering with Soluble Dietary Fiber. *Current Atherosclerosis Reports , 18*(12), 75.

73) Tae-Shik Hahm, S.-J. P. (2009). Effects of germination on chemical composition and functional properties of sesame (Sesamum indicum L.) seeds. *Bioresource Technology, 100*(4), 1643-1647.

74) Toan Duc Pham, T.-D. T. (2010). Morphological evaluation of sesame (Sesamum indicum L.) varieties from different origins. *Australian Journal of Crop Science, 4*(7), 498-510.

75) Uazman Alam, O. A. (2014). Chapter 15 - General aspects of diabetes mellitus. In *Handbook of Clinical Neurology* (pp. 211-222).

76) Van Santvoort HC, e. a. (2008). Probiotics in surgery. . *Surgery , 143*(1), 1-7.

77) Wenjie Li, X. Z. (2019). Effects of hyperglycemia on the progression of tumor diseases. *Journal of Experimental & Clinical Cancer Research, 38*(1), 327-334.

78) Xuebing Han, Y. M. (2023). Regulation of dietary fiber on intestinal microorganisms and its effects on animal health. *Animal Nutrition, 14*, 356-369.

79) Zakaria, R. A.-R. (2020). EFFECT OF BANANA (Musa Balbisiana) FRUITS AND ITS PEELS ON ACUTE HEPATOTOXICITY WITH DIABETIC RATS. *Egyptian J Appl Sci,, 35*(11), 143-157.

80) Zech-Matterne V., T. M. (2015). Sesamum indicum L. (Sesame) in 2nd Century BC Pompeii, Southwest Italy, and a Review of Early Sesame Finds in Asia and Europe. *Vegetation History and Archaeobotany , 24*, 673–681.

81) Zhang, J. W. (2019). Extraction and characterization of phenolic compounds and dietary fibres from banana peel. *Acta alimentaria, 48*(4), 525-537.

82) Zimmerman, H. J. (1978). Drug-induced liver disease. *Drugs, 16*(1), 25-45.