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Indian Traditional Knowledge of Sesame (Sesamum indicum L.): Historical, Ayurvedic, Ethnobotanical and Scientific Perspectives

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ABSTRACT

Sesame (Sesamum indicum L.), commonly known in India as tila or til, is one of the oldest cultivated oilseed crops and has occupied an important position in Indian food culture, traditional medicine, agriculture, religious practices and household life for centuries. Indian traditional knowledge associated with sesame extends from its use as a nutritious food and source of edible oil to its applications in Ayurveda, ritual practices, personal care and indigenous healthcare. Classical Ayurvedic literature describes tila and tila taila (sesame oil) in relation to nourishment, strength, oleation, skin care, wound management and disorders associated with Vata. Historical scholarship also identifies sesame in early Indian textual traditions and documents its role in religious offerings, festivals, social customs and traditional agricultural practices. A recent review of the three major Ayurvedic compendia the Charaka Samhita, Sushruta Samhita and Ashtanga Hridaya reported extensive references to sesame seeds, oil and preparations.

The traditional importance of sesame is increasingly being examined using modern botanical, phytochemical, pharmacological and nutritional approaches. Sesame seeds contain oil, proteins, essential amino acids, fatty acids, lignans, tocopherols, phytosterols and other bioactive compounds. More than 160 phytochemical constituents have been reported from sesame seeds, oil and other plant parts in the scientific literature. Modern studies have investigated antioxidant, anti-inflammatory, hepatoprotective, antihypertensive and other biological activities, although traditional therapeutic claims should not automatically be considered clinically proven.

This paper reviews Indian traditional knowledge of sesame from historical, Ayurvedic, ethnobotanical, nutritional and scientific perspectives. It also discusses the importance of documenting traditional knowledge, conserving indigenous sesame diversity, protecting community knowledge and developing scientifically validated applications.

KEYWORDS
Sesame, Tila, Ayurveda, Indian traditional knowledge, Ethnobotany, Medicinal plants, Sesame oil and Phytochemistry etc.

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1. Introduction

Although apparently originating in Africa and India, this plant is currently cultivated in diverse regions worldwide from semi-arid tropics to temperate areas. China, India, Myanmar, Uganda, Turkey, Nigeria, Thailand, Bangladesh, Ethiopia, Mexico, and Pakistan are the major producers of sesame. Sesame seeds contain a very large amount of oil (50% to 60%), which is why it is called the “queen of oil seeds”. India possesses one of the world's richest traditions of plant-based knowledge. Plants have historically provided Indian communities with food, medicine, fibres, oils, dyes, cosmetics and materials for religious and cultural activities. This knowledge has been transmitted through classical Sanskrit literature, regional medical traditions, household practices, agricultural communities and indigenous

societies (Bedigian, 2004).

Among oilseed crops, sesame (Sesamum indicum L.) occupies a particularly important position. It is commonly called til in many Indian languages and tila in Sanskrit and Ayurvedic literature. Sesame belongs to the family Pedaliaceae and is an annual herb cultivated primarily for its oil-rich seeds. It is regarded as one of the oldest oilseed crops known to humanity, with evidence indicating domestication extending back more than 5,000 years. The importance of sesame in India is multidimensional. It is simultaneously a food crop, oilseed, medicinal plant, ritual substance and commercial commodity. Sesame seeds are consumed directly, incorporated into sweets and bakery products, and used for extracting edible oil. Sesame oil is traditionally used for cooking, massage, skin and hair care, and several Ayurvedic procedures. Historical research has specifically examined sesame from an Indian perspective, including its references in early literature, religious practices, festivals, ethnobotany, agriculture, commerce and Ayurveda. The study of sesame therefore provides an excellent example of how Indian traditional knowledge integrates agriculture, nutrition, medicine, religion and everyday life.

2. Botanical morphology-

Sesame is an erect annual herb. The plant generally develops a branched or unbranched stem, opposite or alternate leaves depending on their position, tubular flowers and elongated capsules containing numerous small seeds. The seeds occur in different colours, including white, cream, brown, reddish and black. Traditional Indian systems recognize different forms of sesame, with Krishna Tila, or black sesame, receiving particular attention in Ayurvedic and cultural contexts.

Sesame being an important oil seed crop, it is annual in habitat and can be cultivated all around the year in different parts of our country (Frary et al., 2015). Visual observation of morphological traits on stem, leaves, flowers and capsules of plants was recorded. The botanical characters of the sesamum plants are as follows.

Root: Develops a taproot system with lateral roots; deep taproot (often reaching ~1 m) with lateral branches, aiding drought tolerance and nutrient uptake.

Stem: The stem is upright, often four-angled (quadrangular), usually covered with fine hairs (pubescent) or slightly hairy, and may be single-stemmed or branched depending on the variety.

Leaves: Petiolate opposite along the lower stem and alternate higher up; shapes range from ovate and lanceolate to lobed or toothed, typically borne on petioles and covered with fine hairs. Lower leaves are often broader or tri-lobed, transitioning to narrower, lanceolate upper leaves with reticulate venation.

Inflorescence & Flowers: Solitary or 1–3 flowers borne in the leaf axils.

Flowers: Borne singly or in small groups (1–3) in the leaf axils. They are tubular, bell-shaped (campanulate), and usually white, pale pink, or purplish with dark markings inside. Flowering is indeterminate, opening gradually from the bottom of the stem upward.

Perianth: Five-lobed calyx and a tubular, bell-shaped (campanulate) corolla ranging from white, cream, or pale yellow to pink or violet.

Pollination: Predominantly self-pollinated, though natural cross-pollination occurs via insects.

Fruit (Capsule): An oblong, four-sided (quadrangular) capsule roughly 2.5–3.8 cm long divided internally by false septa into chambers that splits open at maturity in traditional shattering varieties (Hegde, 2012). Each pod contains multiple rows of small seeds (often around 100–200 seeds per capsule).

Seeds: Small, flat, and pear- or tear-shaped (about 3 mm long), varying in color from white and cream to yellow, brown, or black. They typically contain about 40–60% oil and notable protein and lignans such as sesamin and sesamolin.

2.1 Scientific classification-

Kingdom- Plantae

Division- Angiosperms

Class- Eudicots

Order- Lamiales

Family- Pedaliaceae

Genus-*Sesamum*

Species- sesamum *indicum* L.



Figure-1, Morphology of sesame with seeds

2.2 Distribution and cultivation-

Sesame is cultivated extensively in Asia and Africa and is now grown in many tropical and subtropical regions. Although the precise geographical origin of cultivated sesame has been debated, India has long been recognized as an important centre of diversity, cultivation and traditional use. Indian agriculture contains considerable diversity in sesame varieties adapted to different climatic and soil conditions. It is particularly suitable for relatively dry environments and is an important crop for many small and marginal farmers.

3. Historical background of Sesame-

Sesame has a long association with Indian civilization. Historical research has documented its importance as a food, oil, medicinal and religious crop. The historical significance of sesame can be understood through several dimensions: Food and nutrition, Oil production, Traditional medicine, Religious offerings, Agricultural practices, Social customs, Personal care and Trade and commerce.

The Indian historical literature on sesame has examined references in ancient texts, religious practices, traditional medicine and regional customs. Shah's historical evaluation describes sesame as an important Indian food, oil, medicinal and religious crop and discusses its references in the Atharvaveda, Hindu festivals, religious rites, ethnobotanical practices, agriculture and commerce. The persistence of sesame in Indian culture is particularly remarkable because its uses are not restricted to one region or one knowledge system. Different communities have developed their own culinary, medicinal and ceremonial applications.

Sesame is an ancient crop that has been cultivated in Asia for more than 5000 years. It was at one time exported from India through the Red Sea and on to Europe and later from Egypt to Italy. Slaves from West Africa who were transported to the United States carried sesame seeds with them that they grew to produce “benne”. Sesame has a long history of use in traditional medicines. Black sesame seeds can be more expensive than other seeds due to the belief in Chinese traditional medicine that they have more health benefits. Global applications of sesame seeds, oil, leaves and roots used in folk medicines include treatment of hemorrhoids, wounds, asthma, blurred vision, abdominal pain and ulcers, alopecia, toothaches and gum disease, migraine, menstrual irregularities, and inadequate lactation. Sesame has widespread use globally in salads, and in Asia the seed and oil are routinely used in cooking. Some

Europeans substitute sesame oil for olive oil in cooking. The seed is included in the preparation of numerous food products, condiments and confectionaries that create a unique nutty, roasted flavour. For example, besides being sprinkled on the surface of breads, sesame seeds are added into pastries, cakes and crackers. Sesame is a component of the spice mixture zahtar (oregano, thyme, sumac, and toasted sesame seed) in the Middle East. Also in the Middle East tahini, a butter or paste is made from ground roasted seeds. Other regional dishes with tahini include hummus bi tahini, made with lemons and chickpeas, and also possibly flavoured with garlic, onion, cumin or paprika. A soft, fudge-like confection called halva/halvah, popular in the Balkans and Middle East, combines tahini, sugar, salt and vanilla. Sfouf, also known as yellow cake or curcuma cake, is a popular Lebanese snack made with wheat, tahini, aniseed, turmeric, sugar and pine nuts or almonds. In India til ke laddu is a small, rounded sweet product made with dry roasted til, clarified butter, roasted and crushed peanuts, unrefined cane sugar, and cardamom. Shirini konjedi is Persian sesame brittle (Angamuthu et al., 2025). The Chinese version of sesame paste, zhi ma jiang, uses roasted seeds that may be blended with peanuts. Chinese black sesame buns are made from steamed dough filled with a mix of toasted black sesame seeds, toasted peanuts, lard or butter, sugar and salt. The Japanese custard goma-dofu is prepared with sesame. Also in Japan, sesame is a constituent of the spice blend, shichimi togarashi (chili pepper flakes, orange peel, sesame seed, ginger, seaweed), and is in the sesame salt, gomasio. Sesame seed is considered to be the oldest oilseed crop known to humanity, domesticated 3,000 to 4,000 years ago. Sesamum has many species, most being wild and native to sub-Saharan Africa. Sesamum indicum, the cultivated type, originated in India. It tolerates drought conditions well, growing where other crops fail. Sesame has one of the highest oil contents of any seed. With a rich, nutty flavour, it is a common ingredient in cuisines around the world. The word “sesame,” so widely used today, is first used in The Pharmacopoeia of the United States of America, by Lyman Spalding (p. 250). The term “Sesame seed” is first used in English (Leeds Mercury, West Yorkshire, England, p. 4). The term “sesamum plant” is first mentioned (The Natural Productions of Burmah, by Francis Mason, p. 176). A British Patent applied for by Fritz Goessel is the earliest English-language document seen that mentions a milk made from “sesame or teel seeds.” The patent was accepted in June 1913. The word “tili” is first used to refer to sesame in India (Gazetteer of the Bombay Presidency. 12:152). Sesame seeds add up to fiber and are a nutritious source of plant protein. Sesame seeds help in digestion stimulate blood circulation and benefits the nervous system. Sesame seeds are one of the richest sources of iron and zinc, including sesame seeds in diet would be an ideal. Sesame seeds are the best source of calcium that contains far more calcium than dairy products. Sesame seeds help relieve constipation. Sesame oil effectively treats cracked heels. Sesamin present in these seeds protects the liver from oxidative damage. Therapeutic benefits are exhibited by sesame seeds due to presence of .bioactive components like lignans and phytosterols. Sesame seeds help to lower blood cholesterol and hypertension, act as anti-oxidant, help to prevent alzihmer and provides immunity. The chemical and nutritional difference in different color seeds has shown in table1.

Table-1. Key Chemical & Nutritional Differences

Sr. No	Chemical Component	White Sesame	Brown Sesame	Black Sesame
01	Total Lignans *(Antioxidants)*	Lowest (~2.83–5.66 mg/g)	Moderate (~2.66–6.68 mg/g)	Highest (~3.56–12.76 mg/g)
02	Oil / Fat Content	Highest (especially when hulled)	Moderate	Lowest among the three
03	Protein Content	Lower than darker varieties	Moderate	Highest (correlates with coat darkness)
04	Minerals & Oxalates	Lower (hulling strips outer minerals/oxalates)	High (intact hull retains calcium & iron)	Highest (rich in calcium, iron, & oxalates)

05	Pigments & Tannins	Minimal melanin and tannins	Moderate phenolic pigments	Rich in melanin, tannins, and phenolics

4. Chemical composition of sesame-

Sesame (Sesamum indicum L.) is a highly nutritious oilseed crop valued for its rich composition of proteins, lipids, carbohydrates, dietary fibre, vitamins, minerals, and bioactive compounds. Sesame seeds contain approximately 21.9% protein and 61.7% oil, although their composition varies with genotype and environmental conditions. Traditionally, sesame has been regarded as an important nutritional resource and is often described as an all-purpose nutrient-rich food.

Sesame seeds are an important source of plant-based protein, containing essential and non-essential amino acids required for human growth and development. Sesame proteins comprise four major fractions: albumins, globulins, prolamins, and glutelins, of which globulins are the most abundant, while prolamins occur in comparatively smaller quantities. Sesame protein is nutritionally valuable because of its diverse amino acid composition, although its amino acid balance is not fully equivalent to that of an ideal complete protein. Sesame meal, obtained as a by-product of oil extraction, contains approximately 40–50% protein and is therefore useful in food formulations and animal feed. Sesame protein isolates have demonstrated approximately 89.57% in vitro digestibility in pepsin pancreatin enzyme studies, indicating their potential as functional protein ingredients (Anilakumar et al., 2010). These properties are particularly relevant to the development of affordable protein-enriched foods in regions affected by protein-energy malnutrition. Approximately 19 amino acids have been identified in different parts of the sesame plant, including seeds, roots, stems, leaves, and flowers. These include alanine, arginine, aspartic acid, cysteine, glutamic acid, glycine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, serine, threonine, tyrosine, valine, tryptophan, proline, and γ-aminobutyric acid (GABA). Furthermore, studies have indicated variations in protein content among sesame varieties. A genome-wide association study by Cui et al. reported an association between seed coat pigmentation and protein content, with darker seeds generally exhibiting higher protein levels.

Sesame is one of the richest oilseed crops, containing approximately 45–57% oil, which has earned it the traditional designation of the Queen of Oilseeds. Sesame oil is characterized by a high proportion of unsaturated fatty acids, accounting for approximately 80% of its total fatty acid composition. Oleic acid and linoleic acid are the predominant constituents, while smaller quantities of palmitic, stearic, arachidic, linolenic, palmitoleic, lignoceric, behenic, myristic, caproic, and margaric acids are also present. Linoleic acid is an essential omega-6 fatty acid that contributes to cell membrane structure and normal physiological functions, whereas α-linolenic acid is an essential omega-3 fatty acid involved in maintaining cardiovascular and metabolic health. The combined concentration of oleic and linoleic acids varies considerably among sesame varieties, influenced by genetic and environmental factors.

Carbohydrates constitute another important component of sesame, particularly in the seed hull. Sesame hulls contain approximately 70–80% carbohydrate polymers on a dry-weight basis, primarily consisting of cellulose, hemicellulose, and pectic polysaccharides. These compounds contribute to dietary fibre and have potential applications in food processing and animal nutrition. Several soluble sugars and oligosaccharides have also been identified in sesame seeds, including D-glucose, D-galactose, D-fructose, raffinose, stachyose, planteose, and sesamose. These carbohydrates contribute to the nutritional and functional properties of sesame-derived products (Brar & Ahuja, 1980).

Sesame seeds are an important dietary source of essential minerals required for metabolic activities, bone development, enzyme function, and physiological regulation. Their mineral composition content mg per 100g includes potassium (525.9), phosphorus (516.0), magnesium (349.9), sodium (15.28), iron (11.39), zinc (8.87), and manganese (3.46). The high mineral content makes sesame particularly valuable in vegetarian and plant-based diets. However, the actual nutritional contribution depends on mineral bioavailability and the presence of

naturally occurring anti-nutritional compounds.

Sesame seeds contain certain naturally occurring anti-nutritional compounds, particularly oxalic acid, phytic acid and small quantities of tannins. These substances can reduce the bioavailability of minerals and, under certain dietary conditions, interfere with protein digestion. Oxalic acid combines with calcium to form insoluble calcium oxalate, reducing calcium absorption. Phytic acid, chemically known as myo-inositol hexakisphosphate, binds essential minerals such as calcium, iron, zinc, and magnesium, forming complexes that are poorly absorbed by the human digestive system. It can also interact with dietary proteins and reduce their digestibility. The techniques like soaking, fermentation, sprouting, and cooking help decrease phytate concentrations. In animal nutrition, phytase supplementation can further improve the availability of minerals, particularly phosphorus and zinc, in sesame meal-based diets (Joshi et al., 1961).

Besides its nutritional value, sesame is an important source of bioactive phytochemicals associated with antioxidant, anti-inflammatory, antihypertensive, hepatoprotective, and lipid-regulating activities. Its phytochemical composition varies according to genotype, seed colour, geographical location, climatic conditions, agricultural practices, and processing techniques. Major phytochemical groups identified in sesame seeds, oil, and other plant parts include lignans, polyphenols, phytosterols, phenolic compounds, aldehydes, anthraquinones, naphthoquinones, and triterpenoids. Among these, lignans are particularly important because of

Lignans are the major characteristic bioactive compounds of sesame and are primarily responsible for many of its reported functional properties. The principal lignans include sesamin, sesamolin, sesamol, sesaminol, and sesamolin phenol. These compounds have demonstrated antioxidant potential and are associated with beneficial effects on lipid metabolism, liver protection, and inflammatory responses. Sesamin and sesamolin are the predominant lignans, with reported average concentrations of approximately 2.48 mg/g (range: 1.11–9.41 mg/g) and 1.72 mg/g (range: 0.20–3.35 mg/g), respectively (Pathak et al., 2014). Their concentrations and relative proportions depend on genetic and environmental factors. During thermal processing and oil extraction, sesamolin can undergo chemical transformations, producing compounds such as sesamol, which contribute to the antioxidant properties of sesame oil. Seed pigmentation also influences lignan composition. Black sesame generally contains higher concentrations of certain lignans and total phenolic compounds than some lighter-coloured varieties. Reported total lignan concentrations vary according to seed colour as follows. The black seeds 3.56-12.76 mg/g, brown seeds 2.66-6.68 mg/g., yellow seeds 2.52-5.94 mg/g. and white seeds 2.83-5.66 mg/g., To date, approximately 26 lignan compounds have been isolated or characterized from sesame seeds and aerial plant parts (Kumar & Singh, 2025). These include sesamin, sesamolin, sesamol, sesaminol, sesamolin phenol, episesaminone, pinoresinol, matairesinol, samin, sesangolin, and several glycosylated derivatives of sesaminol and sesamolinol. Their structural diversity contributes to the pharmacological and functional potential of sesame.

Major Bioactive Lignans

Sesamin: Sesamin is the most abundant lignan in sesame seeds and is widely investigated for its antioxidant, lipid-regulating, hepatoprotective, antihypertensive, and potential anticancer properties. Its reported concentration generally ranges from 60.14 to 69.10 mg/100 g, depending on variety and growing conditions. Following ingestion, sesamin undergoes metabolic transformation, primarily involving cytochrome P450 enzymes, and its metabolites are eliminated through urine and bile. During the de-colorization of sesame oil using acidic bleaching clay, sesamin may undergo isomerization to form episesamin.

Sesamolin: Sesamolin is the second major lignan in sesame seeds. Unlike sesamol, it does not contain a free phenolic hydroxyl group and therefore exhibits comparatively limited direct antioxidant activity. However, during heating and processing, sesamolin can be converted into sesamol, contributing to the antioxidant capacity and oxidative stability of sesame oil.

Sesamol: Sesamol is an important phenolic lignan associated with the characteristic aroma, flavor, antioxidant activity, and storage stability of sesame oil (Elleuch et al., 2007). It exhibits considerable potential as a natural

antioxidant and has also demonstrated antimicrobial activity in experimental studies. Its presence contributes to the functional and commercial value of sesame-derived products.

Sesaminol: Sesaminol is a minor, lipophilic lignan found in sesame seeds and is recognized for its antioxidant properties and thermal stability. It occurs naturally in relatively small quantities but contributes to the bioactive composition of sesame products. Sesaminol and its glycosylated derivatives are also important constituents of sesame's phytochemical profile. The proximate and bioactive comparison of sesame seed has shown in table2.

Table-2. Proximate & Bioactive Comparison (per 100g)

Sr. No	Component	White Sesame	Brown Sesame	Black Sesame
01	Total Fat (Oil)	47% – 53%	45% – 47%	45% – 48%
02	Protein	19.8% – 22.2%	19.0% – 23.6%	20.3% – 23.6%
03	Carbohydrates	15.4% – 18.4%	10.8% – 16.5%	16.9% – 17.8%
04	Dietary Fiber	Lower (when hulled)	Moderate to High	Highest (thick outer hull)
05	Total Lignans	2.83 – 5.66 mg/g	2.66 – 6.68 mg/g	3.56 – 12.76 mg/g
06	Ash (Minerals)	4.3% – 5.2%	4.0% – 7.3%	6.1% – 6.2%

5. Pharmaceutical and Pharmacological Properties of Sesame-

Phytochemical investigations have revealed that sesame (Sesamum indicum L.) contains a diverse range of bioactive compounds with considerable nutritional and pharmacological potential. More than 160 chemical constituents have been reported from sesame seeds, oil, and other plant parts. These include lignans, polyphenols, phytosterols, phenolic compounds, fatty acids, tocopherols, vitamins, proteins, essential amino acids, and carbohydrates. Among these constituents, sesamin, sesamolin, sesamol, and other phenolic compounds are particularly important because of their antioxidant, lipid-regulating, antidiabetic, antihypertensive, and potential anticancer activities (Mili et al., 2021). These properties have attracted considerable interest in pharmaceutical research and the development of functional foods and nutraceutical products.

5.1 Antioxidant Activity

Oxidative stress, resulting from an imbalance between free radical production and antioxidant defense mechanisms, contributes to cellular damage and the development of several chronic degenerative diseases. Natural antioxidants have therefore gained considerable attention in pharmaceutical and food research because of their potential to protect biological systems against oxidative damage. Sesame seeds possess significant antioxidant potential due to the presence of lignans, phenolic compounds, flavonoids, and tocopherols. Sesamin, sesamolin, and sesamol are particularly important constituents associated with the antioxidant properties of sesame (Shah et al., 2024). These compounds help neutralize reactive oxygen species and protect cellular components against oxidative damage. Studies have also demonstrated that white sesame seeds contain appreciable quantities of phenolic and flavonoid compounds, contributing to their antioxidant and antiproliferative activities. Consequently, sesame may serve as a valuable natural ingredient in functional foods and nutraceutical formulations.

5.2 Antihyperlipidemic Activity

Sesame has demonstrated considerable potential in regulating lipid metabolism, primarily because of its high content of unsaturated fatty acids, phytosterols, lignans, and tocopherols. Its monounsaturated and polyunsaturated fatty acids contribute to maintaining a favorable blood lipid profile when they replace saturated fats in the diet. Sesamin, one of the major bioactive lignans in sesame, has been investigated for its ability to influence cholesterol metabolism and lipid regulation (Ramachandran & Ramanathan, 1972). Experimental studies suggest that sesamin may reduce circulating total cholesterol, low-density lipoprotein (LDL), very-low-density lipoprotein (VLDL), and triglyceride concentrations while supporting high-density lipoprotein (HDL) metabolism. Additionally,

sesame phytosterols may reduce intestinal cholesterol absorption, while vitamin E and other phenolic compounds contribute to protection against lipid oxidation. These properties indicate the potential role of sesame in managing dyslipidaemia and reducing cardiovascular risk factors.

5.3 Anti-hyperglycemic and Antidiabetic Activity

Sesame is increasingly investigated for its potential role in managing diabetes and associated metabolic complications. Its bioactive constituents, particularly sesamin, sesamolin, sesamol, and γ-tocopherol, have demonstrated promising antidiabetic activities in experimental investigations.

Certain sesame phytochemicals may influence carbohydrate metabolism by inhibiting digestive enzymes, including α-amylase and α-glucosidase, thereby potentially reducing the rate of carbohydrate digestion and postprandial glucose absorption. Furthermore, dietary fibre contributes to slower glucose absorption and improved glycemic regulation. Sesame lignans and antioxidant compounds may also help protect pancreatic and other tissues against oxidative stress associated with diabetes. Experimental studies have additionally suggested that sesame-derived compounds may improve biochemical parameters associated with diabetic nephropathy. These findings indicate the potential application of sesame in developing complementary dietary and pharmaceutical approaches for managing diabetes and its complications. However, clinical evidence remains insufficient to establish sesame as an independent treatment for diabetes.

5.4 Antihypertensive Activity

Hypertension is a major risk factor for cardiovascular diseases, including coronary artery disease, stroke, and heart failure. Sesame has attracted attention as a potential dietary source of antihypertensive compounds because of its lignans, tocopherols, polyunsaturated fatty acids, and phenolic constituents. Sesamin, sesamolin, sesamol, and γ-tocopherol have demonstrated beneficial effects on cardiovascular functions in experimental studies. Sesamin may influence blood pressure regulation through antioxidant mechanisms, modulation of vascular function, and improved endothelial activity. It has also been investigated for its anti-atherogenic, antithrombotic, and lipid-regulating properties (Afroz et al., 2019). Furthermore, sesame lignans may contribute to endothelium-dependent vasorelaxation by improving nitric oxide-related vascular responses.

These pharmacological properties suggest that sesame-derived bioactive compounds may have potential applications in cardiovascular health and the development of functional foods targeting hypertension. Nevertheless, their therapeutic effectiveness requires further clinical investigation.

5.5 Anticancer Activity

Sesame lignans have attracted considerable attention in cancer research because of their potential antiproliferative, antioxidant, and apoptosis-inducing properties. Among these compounds, sesamin, sesamol, and sesamolin have demonstrated promising biological activities in various in vitro and animal studies. Sesamin has been investigated for its ability to regulate cancer-related cellular processes, including cell proliferation, apoptosis, autophagy, and metastasis. Experimental findings suggest that it may inhibit tumor cell growth by influencing molecular signaling pathways associated with cell survival and programmed cell death. Sesamol, another important bioactive constituent, has demonstrated antiproliferative, antimutagenic, anti-inflammatory, and chemopreventive properties in experimental models. Its antioxidant activity may also contribute to cellular protection against oxidative DNA damage. Similarly, sesamolin has been reported to induce apoptosis and DNA fragmentation in human lymphoid leukaemia cells under experimental conditions. Although these findings highlight the potential of sesame lignans as sources of anticancer compounds, most available evidence is based on laboratory and animal studies. Further mechanistic investigations and well-designed human clinical trials are necessary before their application as anticancer therapeutic agents can be established.

6. Sesame in Unani medicine-

Unani medicine has gained considerable attention because of its long-standing traditional practices and the growing interest in plant-based therapeutic resources. Sesame (Sesamum indicum L.), a herbaceous flowering plant

belonging to the family Pedaliaceae, is an important traditional oilseed crop cultivated widely in India, Africa, China, and South America. Besides its nutritional value, sesame has considerable importance in traditional systems of medicine, particularly Unani medicine. Various parts of the sesame plant, including seeds, leaves, and oil, have traditionally been used to manage several health conditions. Experimental studies have also reported antioxidant, antimicrobial, anti-inflammatory, and potential anticancer activities associated with sesame-derived compounds. In Unani medicine, sesame seeds, commonly known as Tukhm-i-Kunjad, are traditionally prescribed for urogenital, gastrointestinal, respiratory, and gynecological disorders. This section highlights the traditional medicinal applications of sesame alongside findings from contemporary scientific investigations. In Unani medicine, sesame is recognized for several therapeutic properties and is used in different formulations, including powders (Safoof), oils (Roghan), decoctions, and suppositories (Hamul). Its traditional applications include the following:

6.1 Gynaecological and Reproductive Disorders

Sesame seeds have traditionally been used to manage menstrual irregularities and certain reproductive health conditions. A decoction of *Tukhm-i-Kunjad* prepared with chickpeas is traditionally considered an emmenagogue. Powdered sesame seeds mixed with jaggery have also been used for urinary incontinence and bedwetting. In Waram al-Rahim (uterine inflammation), formulations containing Tukhm-i-Kunjad and Tukhm-i-Katan (flaxseeds) are traditionally prepared by boiling the ingredients in water and applying the preparation below the umbilical region. Similarly, Roghan-i-Gul combined with sesame oil in the form of Hamul has been described for uterine inflammatory conditions (Al-Din, 2007). Traditional preparations involving sesame seeds, ghee, honey, and jaggery have been reported for menstrual irregularities and amenorrhea. Sesame has also been mentioned in traditional practices associated with labor induction and reproductive health. However, these applications, particularly those involving abortion or labor induction, lack sufficient clinical evidence and should not be considered safe or recommended medical treatments.

6.2 Urogenital Disorders-

In traditional medicine, sesame seeds are considered to possess cooling and diuretic properties and have been used for urinary complaints, including burning during urination, strangury, and urinary calculi. Certain traditional formulations also describe sesame use for oligomenorrhea and other reproductive conditions. Its mineral composition, particularly calcium and zinc, contributes to its nutritional importance in maintaining bone health (Namiki, 2007). Therefore, sesame may be a valuable dietary component for older adults and postmenopausal women, although its consumption alone cannot prevent osteoporosis.

6.3 Gastrointestinal Disorders-

Sesame is traditionally recognized for its stomach-supporting properties, described in Unani terminology as Muqawwi-i-Mi'da. Its seeds are used to support digestion and relieve constipation and indigestion. The natural oils present in sesame may help lubricate intestinal contents, while dietary fibre contributes to normal bowel movements. Sesame oil has also been traditionally used for gastrointestinal complaints, including constipation, diarrhea, and dysentery. Additionally, the combination of sesame seeds and walnuts has been described in traditional medicine for managing bleeding associated with piles.

6.4 Respiratory Disorders-

Sesame seeds and oil have traditionally been used to alleviate cough, throat dryness, and respiratory discomfort. Sesame-based lozenges are described in traditional practices for cough and respiratory complaints. Its oil is also used in preparations intended to soothe throat irritation. Warm infusions of sesame leaves have been traditionally used as gargles to relieve inflammation of the oral and throat mucous membranes.

6.5 Dermatological and Hair Care Applications-

Sesame has considerable importance in traditional skin and hair care. Sesame seeds are used in preparations intended to improve skin appearance and manage abscesses, itching, and certain inflammatory skin conditions. Sesame leaf decoctions have traditionally been applied as scalp washes to support hair growth, while Roghan-i-Kunjad (sesame oil)

is used externally to alleviate inflammation and skin dryness (Mohamed et al., 2021).

Modern scientific investigations have identified several bioactive constituents in sesame, particularly lignans, phytosterols, polyphenols, unsaturated fatty acids, vitamins, and minerals. Sesamin and sesamolin are important lignans associated with antioxidant activity and the regulation of lipid metabolism. Sesame-derived compounds have demonstrated potential to influence hepatic fatty acid oxidation, cholesterol metabolism, and oxidative stress in experimental studies. Its phytosterols may contribute to lowering intestinal cholesterol absorption, while their antioxidants constituents help protect cells against oxidative damage. Sesame also provides iron, zinc, calcium, and B-group vitamins, which contribute to normal physiological functions, immune responses, and bone maintenance. Overall, sesame represents an important link between traditional medicinal knowledge and modern phytochemical research. Its nutritional richness and diverse bioactive constituents support further investigation into its potential applications in pharmaceutical, nutraceutical, and functional food formulations. Nevertheless, traditional therapeutic claims require appropriate pharmacological, toxicological, and clinical validation before being established as evidence-based treatments.

7. Sesame in Indian Traditional Knowledge-

Traditional knowledge concerning sesame may be divided into four broad categories:

- **Nutritional knowledge-**

Sesame seeds are traditionally recognized as energy-dense and nourishing foods. They are consumed whole, roasted, powdered or incorporated into preparations such as sweets and traditional snacks.

- **Medicinal knowledge-**

Traditional systems employ sesame seeds, sesame oil and preparations containing sesame for several purposes, particularly those associated with nourishment, external oleation, skin care and conditions interpreted within Ayurvedic frameworks.

- **Ritual knowledge-**

Sesame has important ritual associations. Seeds are used in offerings and ceremonies and are especially associated with certain Hindu religious observances.

- **Household knowledge-**

Sesame oil has traditionally been used for cooking, body massage, hair care, skin care and various household applications. Thus, sesame represents a plant in which medicinal and non-medicinal knowledge are closely interconnected.

- **Sesame in Ayurveda-**

Ayurveda represents one of the most systematic traditional medical knowledge systems in India. Classical Ayurvedic texts describe medicinal substances according to properties such as taste, potency, post-digestive effect and effects on physiological systems. Sesame is known as Tila, while sesame oil is generally referred to as Tila Taila. Recent scholarship reviewing the Brihatrayee the Caraka Samhita, Sushruta Samhita and Ashtanga Hridaya reports numerous references to sesame and sesame oil. According to this review, sesame is associated with properties related to nourishment, strength, skin health, wound care and management of disorders associated with Vata. Ayurveda is a holistic health approach, which originated in India thousands of years ago. Sesame is known as Tila taila and its oil is known for its therapeutic benefits in Ayurvedic texts (Biju et al., 2025). Ayurvedic knowledge says that sesame provides special strength to those who use it as a medicine and it acts as a strengthened and immunity booster. Sesame oil is one of the best oils mentioned in Ayurveda. Ayurveda mentions the use of mediated oils to treat various disorders. Sesame oil along with herbs and water is cooked for a prolonged period and utilized as mediated oil. Sesame oil is also used in Shirodhara, a calming and soothing technique of the body and mind. Sesame oil is preferred as it is neutral oil and blends well with other essential oils.

8. Sesame as a traditional medicinal substance-

In Ayurvedic literature, sesame is considered a significant dravya (substance). Its importance is related not only to its nutritional value but also to its suitability for medicinal preparations.

Traditional Ayurvedic applications include: internal dietary use; preparation of medicated oils; external massage; skin applications; wound-related preparations; oleation

procedures; hair and scalp applications; use in formulations intended for nourishment and strengthening. These traditional applications should be interpreted within the conceptual framework of Ayurveda rather than directly equated with modern biomedical diagnoses.

- **Sesame and the Concept of Vata-**

One of the important concepts associated with sesame in Ayurveda is its relationship with Vata dosha. Ayurvedic theory describes Vata in terms of movement and physiological functions. Traditional Ayurvedic texts and later interpretations frequently associate sesame oil with Vata-pacifying applications. This traditional association helps explain the historical importance of sesame oil massage in Ayurveda (Panwar & Bisen, 2020). However, it is important from a scientific perspective to distinguish between Traditional Ayurvedic interpretation modern biomedical evidence. A traditional claim does not automatically constitute clinical evidence. Modern scientific validation requires appropriately designed laboratory, animal and human studies.

- **Traditional Uses of Sesame in Indian Food Culture-**

Sesame is deeply integrated into Indian cuisine.

- **Sesame seeds as food-**

Sesame seeds are consumed: roasted; raw in selected preparations; powdered; mixed with jiggery; incorporated into sweets; used as seasoning; incorporated into chutneys and spice mixtures; added to bakery and snack products. One of the best-known traditional combinations is til-gul, particularly associated with the festival of Makar Sankranti in Maharashtra and other parts of India. The expression "Til-gul ghya, goad bola" reflects the cultural association of sesame and jaggery with social harmony and goodwill.

- **Sesame oil as edible oil-**

Sesame oil has historically been used as cooking oil in many parts of India. Its relatively high oxidative stability compared with some other unsaturated vegetable oils contributes to its traditional value. Modern research indicates that sesame seed contains substantial quantities of oil and protein. A recent overview reports sesame seed oil content approximately in the range of 44–63% and protein around 18–25%, although composition varies with cultivar and growing conditions.

9. Religious and Cultural Importance-

Historical studies have documented sesame use in Hindu festivals, religious offerings and rites.

Sesame seeds are traditionally associated with: religious offerings; rituals connected with ancestors; purification-related practices; festivals; ceremonial food; auspicious occasions. In several Indian traditions, sesame is regarded as a symbolically significant substance. The cultural significance of sesame demonstrates that traditional plant knowledge cannot be fully understood by studying medicinal applications alone. The cultural meaning attached to a plant can be as important as its pharmacological or nutritional properties. Beyond Hinduism, sesame serves as a powerful spiritual metaphor and ritual ingredient across several ancient faiths:

- **Buddhism.** Sesame symbolizes extreme austerity and self-discipline. According to, Buddhist texts recount that during his period of severe asceticism prior to enlightenment, the Buddha sustained himself on minimal nourishment—reportedly just a single sesame seed and one jujube fruit a day.
- **Jainism.** In Jain philosophy, the extraction of oil from a sesame seed is used as a classic simile to explain the nature of the soul (jiva). Just as invisible oil permeates the entire seed and must be pressed out to be seen, the pure soul resides invisibly within the physical body.
- **Ancient Babylonian & Mesopotamian Religion.** Sesame was cultivated in ancient Mesopotamia (referred to in cuneiform texts as *še-giš-ì*) and played a central role in temple rituals. As noted by the, ancient Babylonians burned and poured sesame oil in sacred ceremonies to invoke and appease their deities.

During Tarpan (offering water mixed with black sesame seeds and kusha grass to ancestors), specific Sanskrit verses invite ancestors to accept the offering and grant their blessings

10. Ethnobotanical Knowledge of Sesame-

Ethnobotany examines relationships between people and plants. Sesame provides an important example because communities use different plant parts and preparations for

diverse purposes. A comprehensive ethno pharmacological review reports that seeds, oil and other plant organs of sesame have traditionally been used for several conditions, including wounds, inflammation, ulcers, asthma and other ailments.

Sesame has been documented in Indian texts since the Vedic period (1500–500 BCE) and is regarded as Pavitra (inherently pure)

According to the Garuda Purana and Brahma Purana, sesame sprouted from drops of Lord Vishnu's sweat during cosmic creation and Yoga Nidra (divine sleep). The Padma Purana also lists it among the sacred substances that emerged during the churning of the cosmic ocean (Samudra Manthan). While the seed is linked to Vishnu, sesame oil (taila or gingelly oil) is associated with his consort, Goddess Lakshmi. The Atharva Veda mentions storing sesame oil in jars, while the Yajur Veda and Sankhayana Aranyaka reference its use in sacrificial rites and anointing. Later texts like the Mahabharata, Manu Smriti, and Garuda Purana state that offering even a single sesame seed yields merit equal to gold and makes charity imperishable (akshaya). Black sesame (kala til) is indispensable in death and ancestral ceremonies (Tunde-Akintunde & Akintunde, 2004). According to the Garuda Purana explains that sesame's divine essence wards off negative spirits and acts as an energetic conduit, allowing water (tilodak) and food offerings (pindas) to reach ancestors in the subtle realm. Sesame is a primary oblation in Homa and Havan fire rituals. It is also central to users note a common consensus that black sesame oil is widely burned in lamps and used in remedies to ward off negative energy and pacify Saturn's astrological influence.

Invoking the Ancestors (*Garuda Purana*):

"Āgacchantu me pitara imaṃ gṛhṇantvapo'ñjalim"

It means many my ancestors arrive and accept this cupped-hand offering of water [mixed with sesame.

"Pitṛbhyaḥ svadhāyibhyaḥ svadhā namaḥ"

It means "Salutations and sacred nourishment (svadha) to the forefathers who are worthy of ancestral offerings."

"Om Sarva Pitru Devatābhyo Namaḥ"

It means "Salutations to all ancestral deities" (traditionally recited three times while pouring sesame-infused water facing south).

Astrological Remedies for Lord Shani (Saturn)

In Vedic astrology, black sesame (kala til) is ruled by Saturn (Shani), the planet of karma, discipline, and endurance. Traditional Saturday remedies aim to pacify difficult Saturn transits (such as *Sade Sati*

Temple & Peepal Tree Offerings- According to, devotees offer black sesame seeds mixed with jaggery beneath a Peepal tree or pour black sesame over a Shiva Lingam on Saturdays to reduce obstacles.

Sesame Oil Lamps & Chhaya Daan- Lighting a clay or iron lamp (diya) with pure sesame (gingelly) oil on Saturday evenings is widely practiced. In a ritual called Chhaya Daan, a person looks at their reflection in a bowl of sesame oil before donating the oil to ward off lingering misfortune.

Charity (Til Daan) & Havan- Donating black sesame seeds, warm blankets, or iron items on Saturdays or offering black sesame into a Shani Shanti Havan (fire ritual) while chanting ″Om Sham Shanaischaraya Namah″ is believed to balance karmic debts.

Ayurvedic & Seasonal Health Wisdom- Hindu festivals align closely with Ayurveda's seasonal regimen (Ritucharya). Celebrating Makar Sankranti (and Lohri or Pongal) in mid-January with sesame and jaggery (til-gul) serves a direct physiological purpose.

Internal Heat & Vata Balance Mid-winter (Shishira Ritu) increases dryness and coldness (Vata dosha), which can cause joint stiffness and dry skin. According to, sesame has a warming potency (Ushna Virya) and unctuous quality (Snigdha) that lubricates joints, nourishes tissues, and generates internal body heat.

Mineral & Immunity Boost Combining whole sesame seeds with jaggery creates a nutrient-dense winter food. As noted by, unhulled sesame seeds are rich in calcium (roughly 975 mg per 100g) and iron, while jaggery supports digestion and respiratory health during cold weather.

External Oil Massage (Abhyanga) Beyond eating sesame, Ayurveda recommends daily warm sesame oil massages during winter to calm the nervous system, improve circulation, and protect the skin barrier.

Table.-3. Selected traditional uses of sesame reported in the literature

Sr. No.	Plant material	Traditional application
01	Oil cake	Animal feed and agricultural uses
02	Seeds	Food, nutritional preparations, traditional remedies
03	Sesame oil	Cooking, massage, skin and hair care
04	Seed paste	External traditional applications
05	Whole plant	Ethnobotanical applications
06	Leaves	Ethanomedicinal applications in some regions
07	Roots	Reported traditional medicinal applications

The presence of these uses in ethnobotanical literature does not mean that all applications have been clinically validated. They represent documented traditional knowledge that may provide hypotheses for future research.

11. Sesame in Traditional Personal Care-

Sesame oil has been widely used in Indian household practices.

- **Hair care-** Traditional use includes application of sesame oil to the scalp and hair. Such practices are generally associated with: lubrication; reduction of dryness; scalp massage; hair conditioning.
- **Skin care-** Sesame oil has historically been applied externally to the skin, especially in traditional oil massage. Its lipid composition and antioxidant components have stimulated scientific interest in its possible dermatological applications.
- **Massage-** Abhyanga, or oil massage, is one of the best-known traditional applications of sesame oil. From a cultural and historical perspective, Abhyanga demonstrates the integration of medicinal knowledge, daily routine and preventive health concepts within Ayurveda (Shah, 2013).
- **Tahini-** It is paste of crushed seeds that is widely used in Eastern cooking. Tahini mixed with juice, and thinned with water taratoor a sauce that is eaten as a dip with Arab bread as part of a selection of meze, or taratoor is mixed with ground for, another dip. Combines mashed roast with taratoor and onions. Tahini is also used as a sauce ingredient for and dishes.
- **Halvah** any of several confections of Balkan and eastern Mediterranean origin, made with, seeds or, pressed into loaf form or cut into squares. Halvah is made with a variety of colourings and flavourings. Its texture is characteristically and crisp.

12. Traditional Knowledge and Modern Pharmacological Research-

Modern scientific research has investigated sesame extracts, oil and isolated constituents.

A comprehensive review identified reported activities including: antioxidant activity; anti-inflammatory activity; antihypertensive effects; hepatoprotective activity; antipyretic activity; antimicrobial activity; metabolic effects; possible anticancer activity. Another systematic review specifically aimed to bridge traditional information with pharmacological research and concluded that sesame possesses numerous traditional uses that warrant further translational investigation. Important scientific caution the laboratory findings do not automatically establish effectiveness in humans.

Sesame oil is especially notable for its oxidative stability. The oil contains characteristic lignans and antioxidant components that can delay oxidation. This property is one reason of sesame oil has been valued traditionally for food preparation and storage. Scientific studies have investigated sesamin, sesamolin and sesamol in relation to oxidative stress. The antioxidant characteristics of sesame provide an interesting example of how traditional food knowledge can lead to modern biochemical research (Hsu & Liu, 2002). However, the physiological effect of consuming sesame or sesame oil depends on dose, dietary context, individual health status and other factors. Vegetable oils are primarily composed of and are typically liquid at room. They contain a greater variety of than animal fats. Olive oil, for example, contains the monounsaturated fatty acid, which contributes to healthy (HDL, or high-density lipoprotein) levels and may reduce the risk of specifically alpha-linoleic acid

(omega-3) and linoleic acid (omega-6), are found in a number of vegetable oils and contribute to the maintenance of, which help to metabolize cholesterol and absorb the fat-soluble vitamins A D E, and K. These are considered essential fatty acids because they cannot be synthesized by the human body and must thus be obtained from dietary sources. Linseed oil has the highest level of alpha-linoleic acid of any vegetable oil\

13. Nutritional Importance

Sesame seeds are nutritionally dense. They provide: lipids; proteins; carbohydrates; dietary minerals; amino acids; vitamins; phytochemicals. The nutritional composition varies according to cultivar, soil, climate, processing and storage.

Table-4. Major nutritional components of sesame

Sr. No	Component	Importance
01	Lipids	Major source of energy and oil
02	Protein	Nutritional protein source
03	Essential fatty acids	Important dietary lipids
04	Lignans	Bioactive plant compounds
05	Tocopherols	Antioxidant compounds
06	Minerals	Nutritional contribution
07	Amino acids	Protein quality
08	Phytosterols	Plant sterol fraction

The combination of nutritional value and traditional culinary versatility explains why sesame became an important component of Indian food culture.

- **Traditional Sesame Cultivation Knowledge**

Traditional agriculture involves knowledge of: seed selection; sowing time; soil preparation; moisture management; weed control; harvesting; drying; seed storage. Farmers historically selected sesame varieties according to local environmental conditions (Amoo et al., 2017). Traditional varieties can possess valuable characteristics such as: drought adaptation; early maturity; local climatic adaptation; seed colour diversity; oil quality; resistance or tolerance to particular environmental stresses. Therefore, conservation of traditional sesame varieties is important not only culturally but also genetically.

- **Sesame and Sustainable Agriculture-**

Sesame has potential significance in sustainable agricultural systems because it can be cultivated under relatively dry conditions. Its cultivation can contribute to diversification of cropping systems, particularly where farmers seek alternatives to water-intensive crops. Traditional knowledge can contribute to sustainability through: local seed conservation; low-input cultivation; crop diversification; use of locally adapted varieties; traditional storage practices; integration with livestock and mixed farming. Future research should examine how traditional agricultural knowledge can be integrated with modern agronomy without eliminating local crop diversity.

- **Traditional Knowledge and Sesame Biodiversity**

India possesses substantial diversity in sesame germplasm. Different traditional forms can vary in: seed colour; seed size; oil content; flowering time; maturity; plant height; branching; adaptation to drought; disease response. The conservation of traditional germplasm is therefore essential. Traditional knowledge can help identify locally valued varieties that may otherwise disappear because of the replacement of indigenous cultivars by a small number of commercial varieties. Community seed banks, farmer participatory breeding and documentation of traditional varieties can help preserve this biological and cultural heritage. This creates both strength and vulnerability. The strength is that knowledge remains closely connected with practical experience. The vulnerability is that knowledge may disappear when younger generations move away from traditional agricultural and household practices. Systematic documentation is therefore urgently required.

14. Documentation and Protection of Indian Traditional Knowledge-

The documentation and preservation of Indian traditional knowledge have considerable national and international significance. Traditional medicinal knowledge, agricultural practices, and indigenous uses of biological resources have been developed and preserved by local communities over generations. However, inadequate documentation and recognition of these contributions may expose traditional knowledge to unauthorized commercial exploitation and inappropriate patent claims. The protection of traditional knowledge requires recognition of knowledge holders, informed consent, equitable benefit sharing, conservation of biological resources, and ethical research practices. India has established several initiatives to preserve and protect its traditional knowledge, particularly the Traditional Knowledge Digital Library (TKDL), which documents information from traditional medicinal systems such as Ayurveda, Unani, Siddha, and Yoga. It helps patent authorities identify existing traditional knowledge and prevent the granting of inappropriate patents based on previously documented information. In sesame (Sesamum indicum L.) research, similar efforts are necessary to document the traditional knowledge of farmers, indigenous communities, traditional healers, and local practitioners who have maintained its medicinal, nutritional, and agricultural applications over generations. Proper documentation can strengthen the relationship between indigenous knowledge and contemporary scientific research while ensuring appropriate recognition of its contributors.

One of the major challenges in traditional medicine research is transforming traditional observations into scientifically testable hypotheses. Traditional applications provide valuable starting points for experimental investigations, but their therapeutic claims require systematic scientific validation. For example, the traditional use of sesame oil for massage can be investigated through randomized controlled trials, dermatological assessments, biochemical measurements, and safety evaluations to determine its effects on skin health and physiological functions. Similarly, the traditional recognition of sesame seeds as a nutritious food can be scientifically evaluated by analyzing protein quality, fatty acid composition, mineral content, nutrient bioavailability, and their effects on nutritional status. Such an integrated approach allows traditional knowledge to contribute to modern scientific understanding while maintaining appropriate standards of evidence, safety, and ethical responsibility. Further research on sesame offers considerable opportunities in plant biotechnology, molecular biology, pharmaceutical sciences, agriculture, and functional food development.

Molecular and Genomic Research: Future molecular investigations should focus on the biosynthetic pathways of important sesame lignans, particularly sesamin and sesamolin. Studies on gene expression, genetic diversity, metabolic regulation, antioxidant mechanisms, and molecular targets may provide deeper insights into the biosynthesis and biological activities of sesame-derived compounds. Advanced genomic and biotechnological approaches may also help develop sesame varieties with improved nutritional and phytochemical characteristics.

Plant Pathology and Disease Management: Sesame cultivation is affected by several fungal, bacterial, and viral diseases that reduce crop productivity and seed quality. Molecular identification of plant pathogens, characterization of disease-causing organisms, and investigation of host resistance mechanisms are essential for developing effective disease-management strategies. Molecular markers, genomic approaches, and resistant germplasm screening can contribute to sustainable sesame production.

Traditional Medicine and Pharmacological Research: Traditional applications of sesame require further investigation through pharmacognostic studies, phytochemical characterization, pharmacological screening, toxicological evaluation, and clinical trials. Particular attention should be given to understanding the therapeutic potential of sesamin, sesamolin, sesamol, and other bioactive constituents. Such studies can establish their mechanisms of action, effective concentrations, possible adverse effects, and pharmaceutical applications.

Functional Foods and Nutraceutical Development: The nutritional and phytochemical richness of sesame provides

opportunities for developing value-added food products, including protein-enriched formulations, antioxidant-rich functional foods, nutraceutical preparations, and health-oriented dietary products. Research on extraction methods, bioavailability, formulation stability, and processing technologies can improve the commercial and pharmaceutical utilization of sesame.

Safety, Quality Control and Regulatory Considerations

Although sesame has a long history of dietary and traditional medicinal use, its consumption and therapeutic applications do not automatically guarantee safety for every individual or preparation. Sesame is a recognized food allergen and may cause allergic reactions in susceptible individuals. Other important safety considerations include microbial contamination, improper storage, oil adulteration, excessive consumption, and potential interactions between concentrated extracts and medications. Furthermore, the chemical composition and biological activity of sesame products may vary depending on genotype, cultivation conditions, harvesting practices, extraction procedures, and storage conditions. Concentrated phytochemical extracts may also have different biological effects from ordinary dietary quantities of sesame seeds or oil. Therefore, future research should emphasize standardized extraction methods, quality control, contaminant analysis, toxicity assessment, dosage optimization, and appropriate clinical evaluation. These measures are essential for ensuring the safety, efficacy, consistency, and quality of sesame-based pharmaceutical and nutraceutical products.

15. Relationship between Traditional Knowledge and Modern Science-

The relationship can be represented as follows the pathway provides a rational framework for investigating medicinal plants while respecting their traditional origins. The scientific literature supports considerable interest in the biological properties of sesame. However, the evidence varies considerably among different claims. A major review identified extensive phytochemical diversity and numerous pharmacological activities, while systematic reviews emphasize the need for further translational and clinical investigation. Therefore, the appropriate scientific position is neither to dismiss traditional knowledge nor to accept every traditional claim without testing. Instead, traditional knowledge should be considered a valuable source of research hypotheses



Figure 2. Traditional knowledge and modern science relationship

Conclusion-

Sesame (Sesamum indicum L.) represents one of the most important examples of Indian plant-based traditional knowledge. Its history extends across agriculture, food, medicine, religion, household practices and commerce. The Ayurvedic concept of Tila and the extensive use of Tila Taila demonstrate the importance of sesame in classical Indian medicine. Historical research has also documented sesame's association with early Indian literature, religious practices, festivals, ethnobotany and agricultural traditions. Modern phytochemical research has identified numerous bioactive compounds, particularly lignans, phenolic compounds, phytosterols, fatty acids and tocopherols. Pharmacological studies have reported antioxidant, anti-inflammatory and several other biological activities. Nevertheless, traditional medicinal claims must be distinguished from clinically established therapeutic effects. Further research is required to determine appropriate doses, mechanisms, safety and clinical efficacy. The future of sesame research should therefore combine such an interdisciplinary approach can help preserve India's traditional knowledge while developing scientifically validated and sustainable applications of sesame.

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