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THE NUTRITIONAL ROLE OF PUMPKIN SEEDS IN PROMOTING BETTER SLEEP: TRADITIONAL USES AND POTENTIAL BENEFITS

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ABSTRACT:

Background: Pumpkin seeds have long been valued in traditional medicine for their capacity to support many health benefits, such as better sleep. Zinc, magnesium, and tryptophan—nutrients essential for regulating sleep patterns—are particularly abundant in them. These seeds have long been a component of herbal remedies used in many cultures to promote relaxation and better sleep. Modern research is now investigating their potential as a natural cure for sleep disorders. The review showcases the potential of pumpkin seeds for pharmaceutical and nutraceutical applications and calls for further research to fully utilize their benefits.

Methods: A library, SciFinder, Web of Science, Google Scholar, and PubMed have all been used to gather literature. This review provides current details on pumpkin seeds' pharmacology, phytochemistry, distribution, health advantages, and botany.

Result: Bioactive components of pumpkin seeds exhibited a wide array of activities such as Anticarcinogenic, Antidiabetic effects,

Stimulation and insulin secretion. This curative potential highlighted its various beneficial outcomes in the field of drug research and increasing scientific interest in the identification of bioactive compounds responsible for various pharmacological activities. This legume is gaining importance for its use in the pharmaceutical, food and cosmetic products.

Conclusion: Existing literature authenticates the potential benefits of pumpkin seeds from Nutritional as well as medicinal perspective. This Seed needs to be explored for identification, isolation, and characterization of bioactive compounds against varied ailments.

Keywords: Sleep-wake cycle, Dietary intervention, Sleep latency, Sleep quality, Pumpkin seeds

1.INTRODUCTION :

The increased nutraceutical and therapeutic benefits of seeds and nuts' bioactive components has drawn more attention to them in recent years.[1] The family Cucurbitaceae includes the pumpkin (Cucurbita), which is typically produced as a vegetable around the world. Cucumbers and squash are among the plants that are grown in tropical and subtropical environments. There are currently three varieties of pumpkins known as "Cucurbita pepo," "Cucurbita maxima," and "Cucurbita moschata" in the world. [2] Pumpkins are produced all over the world for culinary and medicinal purposes. The traditional usage of pumpkin as a medicine dates back many years, including China, Pakistan, India, Yugoslavia, Argentina, parts of Mexico, America, and Brazil. [3-4] In the United States, pumpkins are widely utilized for Thanksgiving meals and snacks. Caned pumpkins are made from most of the plant flora. The large, flat, oval-shaped seeds, on the other hand, are typically thrown away as agricultural waste.

In certain parts of Mexico, Canada, the United States,
China, and Europe, roasted and salted pumpkin seeds are

eaten as a snack due to their distinct flavor and nutty taste. These days, pumpkin seeds are sold in concentrated
forms made of fermented, sprouted, baked pumpkin
protein and pumpkin protein isolate. [5] Pumpkin seeds
are abundant in useful components, much like any other seed. They are rich in phenolic compounds and their derivatives [6], coumarins, unsaturated fatty acids, flavonoids, proteins [7], phytosterols, triterpenoids, carotenoids, provitamins, pigments, pyrazine, squalene, saponin], and phytosterols. Furthermore, pumpkin seeds contain high levels of potassium, phosphorus, magnesium, and other trace minerals like copper, zinc, manganese, iron, calcium, and sodium [8]. Certain minerals and bioactive have the ability to act concurrently at various or identical target sites, contributing to physiological benefits, enhancing overall health, and lowering the risk of non-communicable diseases like cancers [7, 11, 12,], microbial infections [9-12], hyperglycaemia, and diabetes [13,14] difficulties related to oxidative stress [15–17], prostate issues and problems with the bladder [18,19].

Hepatoprotective, wound healing and hair-growth boosting [21, ,22-25], anthelmintic [26-28], antioxidant [12,29-30], and chemoprotective characteristics [31] are some of the additional therapeutic activities of pumpkin seed extract (PSE). This article was composed using the available articles on pumpkin seeds from online databases (Scopus, Research-Gate, Google Scholar, SciFinder, PubMed, ScienceDirect, and Web of Science).

Fig. (1). Seeds of Pumpkin seeds (Cucurbita maxima)

Fig. (2). Plant of Pumpkin seeds (Cucurbita maxima)

2. TAXONOMY :

Pumpkin (2n = 2x = 40) is a seasonal vegetable crop in the genus Cucurbita and Family Cucurbitaceae.
With eight tribes, 118 genera, and 825 species, this plant family is regarded as one of the largest in the plant kingdom [32-35]. The classification of taxonomy Cucurbita maxima is displayed in [37-41] Table (2)

3.TRADITIONAL USES :

Pumpkins have been utilized historically as a food and medicinal. Pumpkins have been utilized as medicine in nations including Brazil, Mexico, Argentina, China, Turkey, Ukraine, Argentina, and India. They are still used to treat enlarged prostates nowadays. Additionally known to be diuretic and antihelmintic are two pumpkin seeds. Intestinal worms, motion sickness, nausea, impotence, enlarged prostate, and dribbling urination are all treated by them. Additionally helpful in the management of urinary tract infections are these seeds. These seeds have been approved for the treatment of children's bedwetting issues and irritated bladders. Pumpkin seed inclusion in a regular diet has shown to be very helpful for people with diabetes11 and some types of cancer. [36-39] Gossel Williams' (2008) research indicates that these seeds' extracts have been observed to raise the weight of the uterus, the size of the mammary gland, the solidity of the bones, and they may even prevent hyperlipidaemia. These seeds are essential for increasing immunity. Due to its zinc content, it is believed to increase male fertility and promote the healthy growing of the foetus. They are abundant in unsaturated acids, such as linoleic, oleic, palmitic, and stearic acid.

4.NUTRITIONAL VALUE OF PUMPKIN SEEDS (CUCURBITA MAXIMA) :

Pumpkin is one of the well-researched vegetables that prevent disease [43-47], with an annual production of 27 million metric tons worldwide [48]. There is currently a growing interest among health and public health professionals in the role that functional foods play in illness prevention [25,28,29]. Pumpkin

seeds include a wealth of useful functional nutrients. While the nutrients in pumpkin seeds are the main metabolites that support life, the seeds' functional components are crucial for preventing disease and promoting human health. [13,14,49]. While pumpkin seeds have a unique flavor and nutty taste, they can be eaten as snacks unroasted or salted-roasted, while the, cooking, and as a flavor enhancer in gravies and soups. These days, pumpkin seeds can be purchased as pumpkin protein isolate, fermented, or sprouted. [50,51], Since pumpkin seeds are incredibly nutrient-dense and enhanced with nutraceuticals like carotenoids, phytosterols, phytoestrogens, triterpenes, tocopherols, lignans, and saponins—compounds known as phenolic compounds or secondary metabolites—they have an antioxidant capability. [52-54], Pumpkin seeds include a lot of nutrients and vitamins, especially iron, potassium, magnesium, and phosphorus. [53,54,55], as shown in Table (3) More than 95% of the total fatty acids in pumpkin seed oil (PSO) include linoleic, oleic, stearic, and palmitic fatty acids, with approximately 75% of these being unsaturated fatty acids (UFAs) [5, 8, 32 55]. There have also been reports of trace amounts of linolenic and arachidic acid [14,56, 57] Table (5) displays the PSO's fatty acid profile. Because of their ability to prevent cardiovascular illnesses, unsaturated fatty acids have been the subject of much research [57, 58]. They are crucial for the proper development of the brain and nervous system, respectively; they are also said to have health advantage

in the treatment of arthritis, hypertension, and coronary heart disease [9-12,56]. Thus, eating pumpkin seeds can help in reaching the approximated value of recommended daily protein demand in adults ≈0.9 gram of protein /kg/day, and this according to the US/Canadian Dietary Reference Intakes [59]. Evaluation of amino acid concentrations in pumpkin seeds revealed that arginine, glutamic and aspartic acids are the most considerable residues, but tryptophan and methionine are the least as [60] show in table (4) Furthermore, only two fatty acids- linoleic and alpha-linolenic acids—are recognized as being necessary for human health because the body is unable to produce them and must instead obtain them through diet. About 35% of pumpkin seeds are crude protein, which corresponds to a sizable and distinct quantity of amino acids [14]. As building blocks of proteins and metabolic intermediates, amino acids are crucial.

Table 2. Classification of Pumpkin seeds (Cucurbita maxima) [31-34] [38-40]

Sr. No	Taxonomic Rank	Nomenclature	Sr. No	Taxonomic Rank	Nomenclature
i	Kingdom	Plantae- Plantes, Planta, Vegetal, plants	vii	Class	Magnoliopsida
ii	Subkingdom	Viridiplantae	viii	Superorder	Rosanae
iii	Infrakingdom	Streptophyta- land plant	ix	Order	Cucurbitales
iv	Superdivision	Embryophyta	x	Family	Cucurbitaceae- gourds, squasches, citrouilles, gourdes
v	Division	Tracheophyta- vascular plants, tracheophytes	xi	Genus	Vuvurbita L.- gourd
vi	Subdivision	Spermatophytia- spermatophytes, seed plants, phanérogames	xii	Species	Cucurbita máxima Duschesce- Winter squash

The human body's physiological processes depend equally on the food supply of sufficient amounts and high-quality necessary amino acids [56, 63]. Table (4) lists the amino acid makeup of the protein found in pumpkin seeds. Research indicates that pumpkin seed protein isolates have good levels of amino acid bioavailability and resemble soybean protein isolates

Table 1. Vernacular names of pumpkin seeds (Cucurbita maxima)

Language	Vernacular Names
English	pumpkin
Hindi	kaddu
Marathi	kohla
French	citrouille, courge, courgette, patission

French	peponem
Sanskrit	kusmandaka

Table no.3 Nutrient values per 100 grams of pumpkin seeds [8,12,32,55,61,62]

Nutrient	**Nutritional value per 100 g**
Protein	30.23 g
Energy	559 kcal
Total lipid	49.05 g
Fiber	6 g 1
Carbohydrates	10.7 g
Micronutrients (Vitamins)	
Vitamin C	1.9 µg
Niacin	4.98mg
Thiamine	0.27 mg
Riboflavin	0.15 mg
Pantothenic acid	0.75 mg
Vitamin A	16 IU
Vitamin E	35.1 mg
Folate	58 µg
Mineral Deposits	
Iron	8.82 mg
Phosphorous	1233 mg
Magnesium	592 mg
Potassium	809 mg
Zinc	7.81 mg
Manganese	4.54 mg
Copper	1.3 mg
selenium	9.4µg
sodium	7 mg
Phytochemicals	
β-Carotene	9 µg
β-Cryptoxanthin	1 µg
Leutin-Zeaxanthin	74µg

Table no.4 Amino acid values per 100gm of edible portion of pumpkin seed as per USDA National Nutrient Database for Standard (2007)

Amino acid	**Value per 100 g**
Glutamic acid	4.315 g
Arginine	4.033 g
Aspartic acid	2.477 g
Leucine	2.079 g
Lysine	1.833 g
Isoleucine	1.264 g

Threonine	0.903 g
Tryptophan	0.431 g
Methionine	0.551 g
Cysteine	0.301 g
Phenylalanine	1.222 g
Tyrosine	1.019 g
Valine	1.972 g
Histidine	0.681 g
Alanine	1.158 g
Glycine	1.796 g
Proline	1 g
Serine	1.148g

Table no.5 fatty acid (mg/100 g) profiles in pumpkin seeds.

Fatty acid	**Value per 100 g**
Capric acid	0.45
Lauric acid	1.34
Myristic acid	0.01 —0.20
Palmitic acid	1.57 —27.78
Stearic acid	0.78 —13.46
Oleic acid	2.93 —42.80
Linoleic acid	4.59 —69.12
Palmitoleic	0.13 —0.20
Arachidic acid	0.30 —2.20

5. IMPACT OF PUMPKIN SEEDS FOR BETTER SLEEP

The high concentration of essential nutrients like **tryptophan** and **magnesium** in pumpkin seeds, which are important in sleep regulation, has drawn attention to the seeds' potential to enhance the quality of sleep.

5.1 Tryptophan

The primary producers of tryptophan are plants, fungi, and bacteria. It can be produced by them using substances like phosphoenolpyruvate. Animals must obtain tryptophan from outside sources since they lack this enzyme [76]. Melatonin and serotonin are precursors of the amino acid tryptophan. The quality of sleep is indirectly impacted [77,78]. Additionally, it is a precursor of kynurenine, 3-hydroxykynurenine, tryptamine, quinolinic and xanthurenic acids, nicotinamide (vitamin B6), and others [78]. Tryptophan is found in meat, fish, eggs, bananas, oats, pumpkin seeds, sesame seeds, chocolate, dried dates, soy, tofu, tree nuts, peanuts, and dairy products.

Adults should consume between 280 and 355 mg of tryptophan daily, according to dietary recommendations [76]. It comes in the form of L-tryptophan from all of these sources. The research on L-tryptophan's impact on sleep issues is not very clear. We evaluated the impact of daily dosages (<1 g and ≥1 g) on sleep habits. A dose greater than ≥1 g of tryptophan supplementation only resulted in a shorter wake-after-sleep onset, per the meta-analysis. Nevertheless, no additional benefits were noted for other aspects of sleep [79]. Another study examined the connection between tryptophan consumption and sleep quality in 122 college students between the ages of 22 and 25. The findings revealed no connection between tryptophan intake and the quality of sleep. A Mediterranean diet supplemented with tryptophan and magnesium (60 mg each) was administered to the experimental group for 16 weeks, while the control group received simply the regular Mediterranean diet.[80]

5.2 Magnesium

One of the minerals that is most prevalent in the human body is magnesium. It is a cofactor in about 300 metabolic processes, one of which is the synthesis of melatonin [81,82]. It is believed that it interacts with glutamatergic and gamma aminobutyric acid (GABA) to control sleep. Additionally, indirect relaxation of central nervous system activity is brought about via binding to and activating GABA receptors [78]. Additionally, magnesium can lower serum cortisol levels, which may help with better sleep patterns. [81,83] According to Evidence suggests that giving older adults a 500 mg magnesium supplement for eight weeks greatly extended their sleep duration and reduced their sleep latency [81]. A magnesium deficit also reduced the rats' plasma

melatonin levels, which could lead to insomnia [84]. However, the amount of magnesium consumed had no effect on the quality of sleep for those who suffer from depression.[83] Magnesium supplementation had a beneficial effect on the quality of sleep for patients after open heart surgery [84]. 64 women with PCOS were evenly and randomly assigned to a magnesium group (250 mg magnesium oxide/day) and a placebo group (n = 32) for ten weeks in a parallel randomized clinical experiment. Magnesium supplementation had no discernible impact on participants' sleep quality in this study [85]. However, a favorable link between the quality of sleep and serum magnesium levels (in serum) was shown in a cross-sectional study that involved 175 women between the ages of 18 and 40.

5.3 Vitamin B6

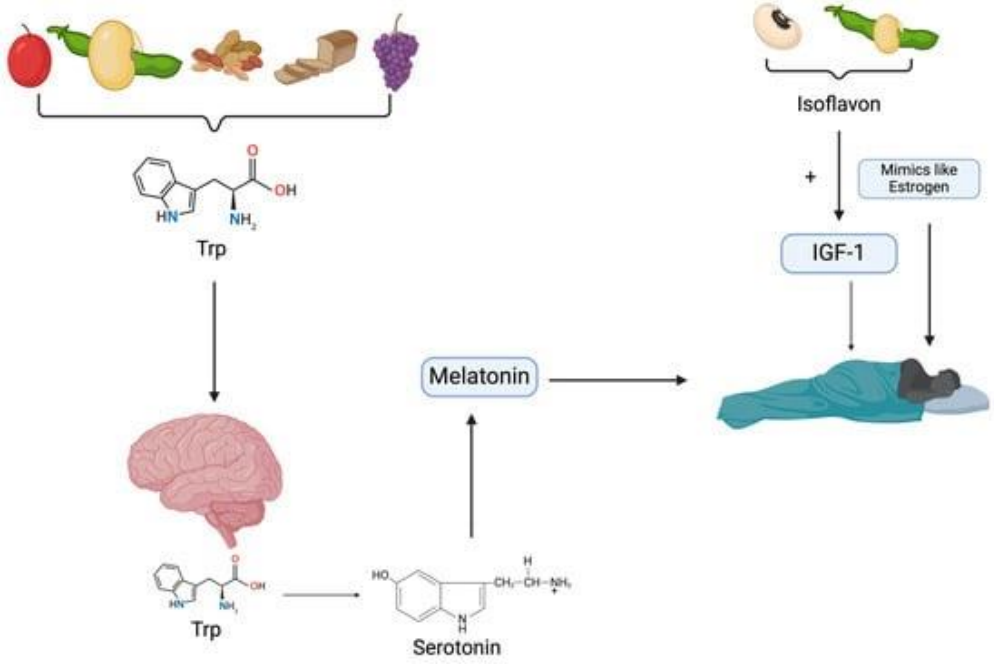
Water-soluble vitamin B6 (pyridoxine) is involved in the synthesis of several neurotransmitters, including glutamate, GABA, dopamine, serotonin, and histamine [87,88]. The main dietary sources of pyridoxin are whole-grain cereals [87]. Its ability to generate specific neurotransmitters is assumed to be the cause of its sleep-regulating action [88]. Nevertheless, nothing is known about the effects of vitamin B6 alone on sleep quality. There is proof that elevated levels of proinflammatory cytokines are linked to sleep problems [89]. By lowering inflammation in the body, vitamin B6 may improve the quality of sleep [90]. 47 adults participated in a randomized, double-blind, placebo-controlled trial to assess the effects of vitamin B6 and poly-γ-glutamic acid (γ-PGA) on sleep quality. The findings indicated that γ-PGA and vitamin B6 significantly impacted sleep quality. [87]

5.4 Tryptophan as a Mediator in Sleep Regulation

Tryptophan, a precursor of melatonin and serotonin (5-hydroxytryptamine, 5-HT), which mostly control sleep, is abundant in plant-based proteins [91]. Tryptophan enters the brain through the diet and is transformed into serotonin, a neurotransmitter that controls sleep. The rate-limiting enzyme that transforms tryptophan into serotonin, tryptophan hydroxylase, is not fully saturated under typical circumstances. Tryptophan levels in the brain rise along with serotonin synthesis when tryptophan saturates this enzyme. Sedation is produced by this procedure [77]. The brainstem's raphe nuclei and midbrain produce the wide-projecting, modulatory neurotransmitter serotonin [92], which is a key neurotransmitter that regulates the body's sleep-wake cycle [93]. Serotonin is recognized to control both awake and sleep, although its exact function is unclear. An enzyme called aromatic L-amino acid decarboxylase (AADC) converts hydroxytryptophan (5-HTP), an intermediate in this process, into serotonin [94].

Research has shown that poor sleep quality is positively correlated with insufficient calcium intake [95]. Because calcium plays a part in the central nervous system, there may be a correlation between poor sleep quality and inadequate calcium consumption. Numerous mood problems, including anxiety and sadness, which are linked to inadequate sleep, have been linked to lower calcium consumption [96]. Because it aids in the brain's synthesis of melatonin from tryptophan, calcium is crucial for good sleep. Tryptophan can be found in a variety of edible plants, including whole grains, nuts, and cherries [97]. Furthermore, via the Mediterranean Tryptophan and melatonin, two substances that promote sleep, may be consumed in greater amounts while following a plant-based Mediterranean diet [91]. Foods high in tryptophan cause the creation of melatonin, which regulates the sleep cycle. The effects of meals high in tryptophan on sleep regulation are depicted in **Figure 1**. aromatic L-amino acid decarboxylase (AADC), an enzyme, by serotonin [93]. Low calcium intake has been positively correlated with poor sleep quality, according to studies [95]. Because calcium plays a part in the central nervous system, there may be a correlation between poor sleep quality and inadequate calcium consumption. Numerous mood problems, including anxiety and sadness, which are linked to inadequate sleep, have been linked to lower calcium consumption [96]. Calcium's significance for the quality ofof sleep.

Figure 1. Illustration of how edible plants promote sleep regulation (Trp: tryptophan; IGF-1: insulin like growth factor-1). Figure 1. Illustration of [98]



6. PHARMACOLOGICAL ACTIVITY OF PUMPKIN SEEDS

6.1 Benign prostate hyperplasia (BHP) effect

Pumpkin seeds are popular for treating BHP because they include a lot of minerals, such as magnesium and zinc, which control prostate growth. A 10% consumption of pumpkin seeds can prevent the citral-induced hyperplasia of the ventral prostate lobe, according to Abdel-Rahman [99]. It improves testis histology, which is beneficial for controlling BHP, and lowers the weight and amounts of prostate protein binding. In both in vitro and in vivo studies, Jiang et al. [100] discovered that the group of patients receiving doses of pumpkin seeds had a decrease in prostate cancer. Pumpkin seeds (C. pepo) have been approved by the European Medicine Agency (EMA/HMPC/136022/2010), according to Gazova [100]. Benign prostatic hyperplasia (BPH), which cures an enlarged prostate and strengthens bladder functions. According to them, pumpkin seeds assist treat bladder issues by balancing hormones by blocking the enzyme 5 α-reductase, which also has anabolic and muscle-strengthening benefits and a direct muscle-relaxing impact that lowers bladder issues. The significance of pumpkin seeds in the treatment of male benign prostate hyperplasia was also mentioned by Alhakamy [101].

6.2 Anticarcinogenic effect

High-quality protein, tocopherols, and other phytosterols found in pumpkin seeds help shield us against serious illnesses. Cucurbitacins derived from C. andreana were shown to have anti-proliferative action against colon, lung, and breast cancer cell lines [102]. The cucurbitane skeleton of cucurbitacins, which are tetracyclic triterpenes and highly oxygenated compounds, is composed of 19-(10→ 9β) abeo 10α lanost 5 ene. They inhibit the COX-2 enzyme and have anti-cancer properties. Ren et al. [103] also investigated 23, 24-dihydrocucurbitacin F (DHCF), a derivative of cucurbitacin, and found that it significantly reduced the proliferative activity of human prostate cancer (PC3) cell lines. Actin aggregation and cofilin-actin formation, cytokinesis, cell cycle arrest, and apoptosis are the causes of this decline.[104] Utilizing its extract against human breast cancer cells (MCF7) and chorionic carcinoma cell lines , researchers investigated the anti-cancerous properties of pumpkin seeds and discovered a cytotoxic effect on the cancerous cells. Additionally, it increased estrogen synthesis in a concentration-dependent way. Cucurbitacins are currently being used as a treatment for benign prostatic hyperplasia and are thought to be a novel anti-cancer agent [70]. Numerous polyphenolic chemicals found in pumpkin seeds are thought to have the ability to regulate a range of inflammatory signals linked to cancer stem cells [105]. When Abou-Elella and Mourad [106] investigated the anticancer properties of an ethanolic extract of C. maxima seeds, they discovered that at a concentration of 100 µ g/mL, cancer cell lines were completely inhibited. [107], Numerous cancer forms are caused by reactive oxygen species (ROS). Foods high in antioxidants help lower the risk of developing cancer.

6.3 Alzheimer's and Parkinson's disease effect

The strength of the synaptic connections between neurons and the generation of new hippocampal neurons have a significant impact on memory performance. External factors like diet and exercise shield existing neurons from oxidative stress and other harmful substances like stress hormones. It promotes neurogenesis and brain-derived neurotropic factors (BDNF), which are in charge of the survival, differentiation, and proliferation of neurons. Glutamate controls how well BDNF functions [108]. The hippocampus, prefrontal cortex, and amygdala all contain a large number of gluco-corticoid receptors Because it has been shown to harm hippocampal neurons through neuroinflammation [109], lower hippocampal BDNF levels, and hyperphosphorylate Tau in the hippocampal region, gluco-corticoid receptor activation is linked to memory impairment. Exercise, sunflower and pumpkin seeds, and black mulberry fruit extract supplements reduce the serum glucose corticoid receptor-α values [113], further diminishing the likelihood of Alzheimer's disease and other illnesses affecting memory. Townseed and Tucker added that pumpkin seeds can help prevent Alzheimer's disease. sickness. According to Kumar et al. [112], phenolic compounds are possessing capacity to shield against a number of illnesses and aid in lowering the Parkinson's disease risk.

6.4 Antidiabetic effects

Diabetes is the most prevalent disease in the world, and numerous research have proven that pumpkin seeds work well against diabetic mice. According to a study by Adams et al. [114], using pumpkin seeds improved the conditions of hyperglycemia and diabetes. In an in-vivo investigation using rats, Bharti et al. [115] examined the dose-dependent impact of tocopherols isolated from pumpkin seeds on diabetic mellitus. When diabetic rats were given greater doses of pumpkin seed extracts assessed by docking (HOMA-IR), there was a noticeable drop in their blood glucose levels. Pumpkin seed tocopherols-controlled lipogenesis, hyperglycemia, and hypertriglyceridemia. The α-amylase and β-glucosidase inhibitory activity in the extract of C. maxima seed, which has antidiabetic properties, was observed by Kushawaha et al. [115].

6.5 Arthritis and Bone protective Effects

Pumpkin seed-based meals high in zinc are also used to stop bone fractures [116]. Zinc boosts the immune system and promotes bone density in people at risk for osteoporosis. Eating pumpkin is very good for postmenopausal ladies. The beta-carotene and γ-tocopherol in pumpkin seeds have anti-inflammatory properties and can be used to treat arthritis and other conditions that cause painful swelling, [117]. Pumpkin seeds have higher anti-inflammatory and therapeutic properties than prescription drugs, per a number of studies. In a test that compared the effects of eating pumpkin seeds with indomethacin, a common medicine for arthritis, the former performed rather well. The breakdown of the lipids in the joint linings was actually better with pumpkin seeds than with indomethacin. Inflammation associated with arthritis has been demonstrated to be naturally reduced by pumpkin seeds. They don't increase the amount of dangerous fat in the joint linings.

7.CLINICALTRIALS (HUMAN AND ANIMAL STUDIES) :

Clinical studies have demonstrated a link between eating pumpkin and β-carotene in depressed patients and higher brain levels of serotonin and norepinephrine, which are known to reduce depression.Selecting the appropriate diet Packed with vital micronutrients can boost the body's adaptive immunity, thwarting pathogen attacks.

It is impossible to overestimate the importance of eating a nutritious diet in the fight against infectious diseases. Crude fiber and proteins, especially pumpkin seed proteins that contain peptides essential for supporting healthy human bodily functioning, are plentiful in pumpkin, its flesh, peel, and seed powders.[72], According to a study by Quanhong [73], the polysaccharides that are derived from pumpkin fruits are responsible for the hypoglycemic effects of pumpkin. In rats with alloxan-mediated diabetes, the study assessed the hypoglycemic action of these polysaccharides. Better glucose tolerance was shown by lower blood glucose levels and higher blood insulin levels. Furthermore, a further study by Fahim [74] confirmed that pumpkin has anti-inflammatory properties, with pumpkin seed oil effectively treating arthritis by preventing adjuvant-induced arthritis in rats. When added to medications, natural ingredients from pumpkin can strengthen their anti-inflammatory properties. Additionally, scientists showed that pumpkin fruit extracts considerably boosted the activities of superoxide dismutase and glutathione peroxidase while lowering the levels of malonaldehyde in mice. Additionally, pumpkin polysaccharides in the serum of tumor-containing mice exhibited higher levels of glutathione peroxidase and superoxide dismutase.[75] the seeds

FUTURE PERSPECTIVES AND CONCLUSION :

Pumpkin seeds fall into the category of extraordinary foods with amazing qualities and are nutrient-dense. Pumpkin seeds' nutritional and bioactive qualities make them a useful food that may also be used to extract oil. Previously seen as waste and unused, pumpkin seeds are now used in many different ways due to their neutraceutical qualities. It can be consumed roasted or as breakfast cereal, or it can be added to soups, baked goods, and other dishes. Numerous pharmacological qualities found in pumpkin seeds aid in the treatment of a number of conditions, including cancer, cardiovascular disease, benign prostatic hyperplasia (BPH), Alzheimer's disease, Parkinson's disease, and others. Additionally, it aids in the treatment of bladder issues as well as other illnesses like diabetes and high blood sugar levels. Antioxidant chemicals found in abundance in pumpkin seeds improve life and shield us from a number of illnesses. The benefits of consuming pumpkin seeds for pharmacological and nutraceutical purposes are outlined in this review along with their value. Changes in the nutritional and anti-nutritional content of seeds during the processing and value-adding stages offer valuable information about the potential applications of pumpkin seeds as a protein substitute to improve large-scale industrial food preparations or to extract oil using different techniques to improve the quality of edible oil.

LIST OF ABBREVIATION :

Ca = Calcium
Mg = Magnesium
Fe = Iron
COX-2 = Cyclooxygenase 2
GABA = Gamma-aminobutyric acid
γ-PGA = poly-γ-glutamic acid
5-HTP =5- hydroxytryptamine
AADC = aromatic L-amino acid Decarboxylase
EMA = European Medicine Agency
BPH = Benign prostatic hyperplasia
DHCF = Dihydrocucurbitacin F
ROS = Reactive oxygen species
BDNF = Neurogenesis and brain- derived neurotropic factors
HOMA-IR=Homeostatic Model Assessment for Insulin Resistance
PCOS=Polycystic Ovary Syndrome

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