NUTRITIONAL COMPOSITION, BIOACTIVE COMPONENTS, AND HEALTH BENEFITS OF PUMPKIN SEEDS: AN OVERVIEW

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ABSTRACT

The pumpkin seeds are tiny in size, but they are incredibly rich in various beneficial nutrients and nutraceuticals, including amino acids, phenolic compounds, phytosterols, unsaturated fatty acids, tocopherols, cucurbitacins, and valuable minerals. Though the flesh of pumpkin has found its way into the Indian diet, the seeds have almost always been discarded as waste in spite of their great nutritive value. A healthy existence and overall well-being depend on all the bioactive substances present in pumpkin seeds. Bioactive compounds in pumpkin seeds exhibit promising activities such as anthelmintic, antidiabetic, antidepressant, antioxidant, antitumor, and cytoprotective. Furthermore, these bioactive carry potential for ameliorating microbiological infections and hepatic and prostate disorders. This review article will be discussed about nutritional composition, bioactive compounds and health benefits pumpkin seeds.

INTRODUCTION

In recent years, pumpkin seeds have gained more attention due to their bioactive components, strong nutraceutical and medicinal potential. Pumpkins are a type of vegetable crop in the Cucurbitaceae family. Even while the flesh of many vegetables has long been a part of Indian cuisine, the seeds—despite their high nutritional value—are nearly universally thrown out as waste. Following harvest, the seeds are frequently thrown away, broken up for fertilizer, or fed to animals. In India, after being salted and roasted, only little quantity of seeds is consumed; the rest are wasted in calf fodder. Although most people consider pumpkin seeds to be an agricultural waste (Amin et al., 2019; Pham et al., 2017), but they actually contain a wealth of nutrients and have intriguing nutraceutical qualities (Aziz et al., 2018). In the snack food market, pumpkin seeds are currently becoming more popular as a healthier substitute for other fried foods. The last ten years have seen a significant rise in India's demand for novel, commercially feasible, and nutritionally good foods. Pumpkin seed oil contains a high percentage of unsaturated fatty acids, it is great for boosting the nutritional content of meals. Pumpkin seed oil has been linked to several health benefits (Tsai et al., 2002). The primary health benefit of pumpkin seed oil is its ability to prevent prostate growth and reduce its size (Gossell-Williams et al., 2006). Furthermore, research backs up the assertions that pumpkin seed oil lowers hypercholesterolemia, treats arthritis, and prevents the onset of hypertension (Caili et al., 2006).

It has been demonstrated that pumpkin seed oil is a significant source of vitamin E (tocopherol) in Japanese diets. Diets high in pumpkin seeds have also been associated with lower incidence of colorectal, lung, breast, and stomach cancers. Carotenoids from all forms of pumpkin fruit have been linked to the prevention of prostate cancer, and the various carotenoid pigments found in pumpkin seed oil may also be health advantages (da Silva et al., 2017). Despite offering the health benefits indicated above, research has shown that pumpkin seed oil lacks antibacterial qualities. According to (Murkovic et al., 2004), toasting seeds enhances their nutritional value. In essence, roasting increases the amounts of vitamin E and sterols. The strong antioxidant properties of tocopherols might be very significant. Scientists have discovered that pumpkin seeds possess antidiabetic, antihypertensive, anticancer, antibacterial, anti-hypercholesterolemia, intestinal anti-parasitic, anti-inflammatory, and analgesic qualities using contemporary methods. Pumpkin seeds, which are usually considered agricultural trash, contain bioactive compounds that have intriguing nutraceutical properties (Amin et al., 2019). Because pumpkin seeds include zinc, phosphorous, magnesium, potassium, and selenium, they are a nutritional powerhouse and an effective tool against a variety of diseases, such as prostate cancer, inflammation, and arthritis. Despite being seen to be a waste of time and resources; pumpkin seeds may now be important to the food supply due to their nutritional potential. They don't harm people's health and are safe to eat on a regular basis (Devi et al., 2018).

NUTRITIONAL COMPOSITION OF PUMPKIN SEEDS:

Nutrients that are practical and beneficial are abundant in pumpkin

KEYWORDS

Bioactive Compounds
Pumpkin seeds
Nutritional Values
Nutraceuticals

ABSTRACT

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seeds. The nutrition of pumpkin seeds contains the primary metabolites necessary for life, but the functional elements of the seeds also have significant effects on preventing disease and improving human health. Pumpkin seeds are a nutritional powerhouse because they are a great source of nutrients and are packed with minerals, primarily zinc, phosphorous, magnesium, potassium, and selenium, which are known to combat disease. These minerals can be used as a weapon against conditions like arthritis, prostate cancer, inflammation, and so on. Although they were once seen to be a waste, their nutritional value has made them valuable ingredients in cooking. They don’t have any negative health impacts when ingested frequently (Maheshwari et al., 2014).

1.1. Nutritional composition of pumpkin seeds:

<table>
<thead>
<tr>
<th>Sample</th>
<th>TEST PARAMETER</th>
<th>REFERENCES (Singh &amp; Kumar, 2022)</th>
<th>REFERENCES (Batool et al., 2022)</th>
<th>REFERENCES (Devi et al., 2018)</th>
<th>REFERENCES (Elinge et al., 2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumpkin Seeds</td>
<td>Protein (%)</td>
<td>25-37</td>
<td>30.23</td>
<td>30.23</td>
<td>27.48</td>
</tr>
<tr>
<td></td>
<td>Carbohydrate (%)</td>
<td>18-25</td>
<td>10.69</td>
<td>10.71</td>
<td>28.03</td>
</tr>
<tr>
<td></td>
<td>Fat (%)</td>
<td>25-50</td>
<td>49.05</td>
<td>49.05</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Energy Value (Kcal)</td>
<td>********</td>
<td>180.28</td>
<td>559</td>
<td>564</td>
</tr>
<tr>
<td></td>
<td>Dietary Fibre (%)</td>
<td>3-6</td>
<td>6.01%</td>
<td>6.00</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Moisture (%)</td>
<td>6.37-6.56</td>
<td>********</td>
<td>********</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Ash (%)</td>
<td>3-5</td>
<td>4.77</td>
<td>********</td>
<td>5.50</td>
</tr>
</tbody>
</table>

1.2. Role of bioactive compounds present in pumpkin seeds

A wealth of beneficial nutrients and nutraceuticals, including amino acids, phytosterols, phenolic compounds, tocopherols, unsaturated fatty acids, cucurbitacins, and important minerals, are concentrated in pumpkin seeds. Each and every one of these bioactive compounds is essential to wellbeing and a healthy life. Promising properties including anthelmintic, antidepressant, antidiabetic, anticancer, antioxidant, and cytoprotective are displayed by these bioactive compounds of pumpkin seeds. Additionally, they may also be able to treat illnesses related to the prostate, liver, and microbiology. In addition, according to Koh et al. (2018), pumpkin seeds are an excellent source of magnesium, potassium, and phosphorus in addition to other trace minerals like zinc, manganese, iron, calcium, sodium, and copper. With the potential to provide physiological benefits, enhance wellbeing, and lower the risk of non-communicable diseases like tumors, microbial infections, hyperglycemia and diabetes, oxidative stress-related complications (Blaskovich et al., 2003), prostate disorders (Ren et al., 2012), and urinary bladder complications (Alhakamy et al., 2023), some of these bioactives and minerals act simultaneously at different or identical target sites.

1.4 The potential of pumpkin seeds for disease prevention

Pumpkin seeds, which are typically thrown out during processing, are incredibly nutrient-dense, offer the highest-quality oil, and are a great source of protein. They are also an excellent source of vitamins that are beneficial to health, dietary fiber, minerals, and monounsaturated fatty acids, which are heart-healthy. Around the world, people are familiar with and love the distinct flavor of pumpkin seeds and oil, which also helps to generate an aromatic flavor while roasting. Pumpkin seeds are receiving a lot of attention lately because of their excellent nutritional and health-protective qualities as well as their pharmacological actions, which include antidiabetic, antifungal, antibacterial, anti-inflammatory, and antioxidant benefits (Nkosi et al., 2006). Pumpkin seed oil’s high unsaturated fatty acid content also makes it a good choice for enhancing the nutritional value of meals (Revathy et al., 2013). Pumpkin seeds and their bioactive components have been shown in numerous studies to have positive benefits on human health and well-being.

- **Hypertensive and Heart Protective Effects**

A natural remedy that is frequently used in folk medicine to treat prostatic hypertrophy is pumpkin seed oil. In the current investigation, the effects of treating rats with 50 mg/kg/day of the nitric oxide synthase inhibitor Nω-nitro-l-arginine methyl ester hydrochloride (l-NAME) for hypertension were examined and contrasted with those of amlodipine, a calcium channel blocker. For six weeks, one daily oral dose of either pumpkin seed oil (40 or 100 mg/kg), amlodipine (0.9 mg/kg), or vehicle (control) were administered. Measurements included arterial blood pressure (BP), heart rate, electrocardiogram (ECG) variations, blood glutathione, plasma malondialdehyde (MDA), serum nitric oxide (NO) levels (the ratio of nitrite to nitrate), and erythrocytic superoxide dismutase activity (El-Mosallamy et al., 2012). The experiments findings indicate that pumpkin seed oil has anti-hypertensive and hypolipidemic properties. Due to its lower absorption than cholesterol, sterol content of pumpkin seed oil has been demonstrated to have a favourable impact on lipid profiles. Additionally, it can avoid problems linked to oestrogen availability or insufficiency. Pumpkin seed oil has a beneficial impact on the extremely complicated metabolism of High-Density Lipoprotein, as evidenced by its exceptional defense against the advancement of endothelial dysfunction, oxidation, and atherosclerosis. According to the findings of this study, Pumpkin seed oil helps to raise High Density Lipoprotein while lowering Low Density Lipoprotein and Diastolic Blood Pressure. There were no documented or noticed harmful effects of the intervention.

- **Antidiabetic Effects**

Diabetes mellitus is one of the conditions that most commonly affects older persons. In Mexico and China, herbal remedies—which often include pumpkin—are used to treat hyperglycemia (Andrade-Cetto et al., 2005). The anti-diabetic qualities of pumpkin flesh, seeds, and peel have recently been the subject of extensive investigation (Rolnik and Olas, 2020). This study shows that the body produces more insulin while using pumpkin powder, which decreases blood sugar levels. Thus, it also lessens the chance of kidney injury (Ahmad and Khan, 2019; Chen et al., 2005).

- **Treatment of functional disorders of bladder**

Pumpkin seed oil has long been used to treat micturition disorders resulting from an inflamed bladder and problems associated to an enlarged prostate gland. Pumpkin seeds are used in treatment because of their therapeutic effect on the bladder’s and sphincter’s relaxation. Lipid components in pumpkin seed oil have been proven in studies (Stevenson et al., 2007) to improve bladder compliance and decrease bladder and urethral pressure. Pumpkin seed oil is also used to address minor issues with the prostate gland.
and bladder caused by benign hyperplasia (BHP), according to (Gohari et al., 2011).

- **Arthritis and Bone Protective Effects** -
  
  Meals high in zinc that are prepared with pumpkin seeds are also used to avoid bone fractures (Bunde-Tsegba et al., 2020). Zinc boosts immune system function and maintains bone density in people at risk of osteoporosis. Eating pumpkin is particularly good for postmenopausal women. The anti-inflammatory properties of c-tocopherol and B-carotene in pumpkin seeds can be used to treat arthritis and other conditions that cause painful swelling (Jeznach et al., 2012). Pumpkin seeds have been shown in numerous studies (Biesiada et al., 2009) to have higher restorative and anti-inflammatory properties than prescription drugs. In a test comparing the consumption of pumpkin seeds with indomethacin, a common medicine for arthritis, the former performed rather well.

- **Anthelmintic Effect** -
  
  In North America and Mexico, traditional medicine has used pumpkin seeds as an anthelmintic and as a supportive treatment for illnesses of the functional bladder (Abd El-Aziz, and Abd El-Kalek, 2011). A weakened immune system makes a person more vulnerable to parasite infections, which are typically associated with a rise in pathogenic bacteria and a fall in Lactobacillus acidophilus and other good bacteria. Pumpkin seeds, papaya extract, flaxseeds, beet root, citrus pectin, and psyllium husks work together to help remove parasite infection.

- **Anticarcinogenic Effects of pumpkin seed and seed oil** -
  
  Cancer can be avoided by taking dietary supplements and eating the correct meals. Numerous investigations have examined pumpkin's potential to prevent cancer. It has been reported that consuming pumpkin seeds lowers the risk of lung, breast, and rectal cancer (Batool et al., 2022). Pumpkin seeds contain lignans that have been demonstrated to have anticancer properties, including those for cancers of the breast, endometrial, colon, and prostate. These lignans, which are only anticancer when eaten and converted into mammalian lignans by intestinal bacteria, especially enterolactone and enterodiol, are the source of the anticancer characteristics of pumpkin seeds (Bunde-Tsegba et al., 2020f). Pumpkin seeds are rich in phytoestrogens called lignans and flavones.

- **Antidepressant Effects of pumpkin seeds** -
  
  Depression is a common condition that results in periods of inhibited psychosocial functioning, lowers quality of life, and presents with symptoms including focus problems, excessive guilt, disturbed sleep and hunger, and even suicidal thoughts. According to the antidepressant food score (APS) chart that was just released by (LaChance and Ramsey, 2018), who profiled the antidepressant foods, pumpkin seeds scored 47%. This suggests that there may be an antidepressant benefit to pumpkin seeds. Another study used forced-swimming and tail-suspension tests to examine the efficacy of pumpkin seed extracts (PSE) and the prescription drug imipramine in rats. The study's conclusions indicate that pumpkin seeds have potent antidepressant qualities (George and Nazzri, 2012). Furthermore, research focused on clinical and animal trials is needed to reveal and validate the positive effects of pumpkin seeds on depression. There isn't much information available in this area on pumpkin seeds' potential.

- **Antimicrobial Effects of pumpkin seeds** -
  
  In spite of a clean environment and a hygienic food, bacteria, parasites, viruses, and fungi are the main causes of death for a large number of people. They cause a variety of diseases and cause death. The oil obtained from pumpkin seeds contains the antimicrobial elements that have been found in pumpkin seed oil (Shahnaz et al., 2019). Pumpkin seed oil, at a dosage of 2%, inhibits the growth of Aeromonas veronii, Candida albicans, Enterococcus faecalis, Escherichia coli, Salmonella enterica, Typhimurium, and Staphylococcus aureus (Hammer et al., 1999).

  Researchers have looked into harnessing the basic proteins found in pumpkin seeds—MAP2, MAP11, and MAP4—to stop yeast cells from growing. Out of all the proteins, the MAP11 basic protein showed the strongest inhibitory effects.

- **Preventive Properties of pumpkin seeds against liver disease** -

  Numerous researchers have already established the liver-protective effects of pumpkin. In another study using CCl4-affected rats, the main ways that pumpkin seed protein isolate improved antioxidant activity and decreased liver enzymes were to find the hepatoprotective impact. These studies support the idea that when liver damage is caused by a low-protein diet or malnutrition, pumpkin seed protein isolates have an affinity to lower the elevated levels of liver enzymes (ALT, AST, ALP, and LD). The identical modifications to these liver enzymes brought on by eating pumpkin were documented by (Batool et al., 2022).

  2. CONCLUSION:

  With growing public knowledge of clean and efficient energy sources, waste management technology, and sustainable agriculture, pumpkin seeds have a chance to take up new and developing market share in the snack food sector. According to these data from several studies, there is potential to develop unique value-added products that are high in nutrients and can reduce pumpkin seed waste. Pumpkin seeds have generally piqued the interest of numerous researchers worldwide who have investigated the possible activities of pumpkin seed oil (PSO) or pumpkin seed extract (PSE) and reported that they had antimicrobial, antiinflammatory, hypoglycemic, antherplastic, antitumor, and cytotoxicity qualities. In the meantime, a few study gaps were found in the body of knowledge already available on pumpkin seeds to support their usefulness as a possible functional food ingredient and demonstrate their biological activities. Given that they are a rich source of nutrients and oil, using these seeds to food products can be thought of as a good substitute for improving their nutritional value.

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