E-ISSN: 2663-1067
P-ISSN: 2663-1075
NAAS Rating: 4.74
www.hortijournal.com
IJHFS 2025; 7(3): 35-44
Received: 15-01-2025
Accepted: 23-02-2025

Riya Gautam
Babasaheb Bhimrao Ambedkar University, A Central University, Lucknow, Uttar Pradesh, India

Harsh Prakash Sharma
Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Mrinalini Tiwari
Babasaheb Bhimrao Ambedkar University, A Central University, Lucknow, Uttar Pradesh, India

UV Kiran
Babasaheb Bhimrao Ambedkar University, A Central University, Lucknow, Uttar Pradesh, India

Corresponding Author:
Harsh Prakash Sharma
Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Pumpkin: A review of nutritional and medicinal properties with its food uses

Riya Gautam, Harsh Prakash Sharma, Mrinalini Tiwari and UV Kiran

DOI: https://www.doi.org/10.33545/26631067.2025.v7.i3a.278

Abstract
Pumpkins are widely known as a member of the *Cucurbitaceae* family, genus *Cucurbita*. Pumpkins are among the major cultivars of vegetables and give good amount of nutrients like minerals, vitamins, carbohydrates and fiber. As far as human nutrition is concerned, pumpkin is particularly a strong resource for anti-oxidants due to presence of functional components of phytonutrients i.e. carotenoids, vitamin E, zeaxanthin, ascorbic acids, selenium, phytosterols, and linoleic acids. Pumpkin is popularly used as traditional medication for cure of several diseases like anti-tumor, antibacterial, anti-diabetic, anti-hypertensive, intestinal anti-parasitic, anti-hypercholesterolemia and anti-inflammation. In the views of above nutritional and medicinal benefits, Pumpkin has vast scope in production of value-added novel food products such as cookies, chutney, sauces, puree, pickle, jam, jelly, marmalades, weaning mix, pies, ready to serve, squashes, nectars and other beverages. The broad endeavor of this review is to understand the health benefits of pumpkins in addition to their nutritional value, as well as to study the scope of the production of value-added food products from pumpkin fruits.

Keywords: Pumpkin nutrition, anti-oxidant, anti-hyperglycemic, functional food, value addition, phytonutrients, therapeutic, *Cucurbita pepo*, radical scavenger, medicinal properties, health benefits, bioavailability, food applications, β-carotene

1. Introduction
Fruits and vegetables are highly significant in the diet since they provide an equal quantity of nutrients, particularly carbs, minerals, vitamins, and fiber, and they are always considered to be among the healthiest food crops. Vegetables include O_2 radical scavenger's including fiber, β-carotene, ascorbic acid and calcium, which can lower the hazard of premature aging, cardiac disease and cancer etc. Amongst each of them, pumpkin serves as one of the key agricultural products, and owing to its nutritious as well as therapeutic properties, it continues to be a significant crop of vegetables today (Abd El-Aziz *et al*., 2011) [1]. In India, pumpkin is acknowledged as 'kaddu', 'Sita-phal,' or 'Kashiphal' and is an affiliate of the *Cucurbitaceae* family and the genus *Cucurbita*. The vegetable cultivation includes Ficifolia, C. *Pepo,* C. Maxima, C. *Moschata*, and Telfairia occidentalis. Among them C. *maxima* Duch, C. *pepo* L. and C. *moschata* Duch, are commercially significant species with high output and are grown globally. C. *moschata* originated in Central America and was cultivated in Mexico for at least 5000 B.C. and Peru 3000 B.C. It is currently widely dispersed around the planet. It is claimed to be the most extensively cultivated *Cucurbita* in the United States tropics. *C. moschata* is a dicotyledonous plant with a succulent soft hairy stem. It is a yearly climber that grows to 3 meters and produces flowers and fruits containing many seeds. The leaves of pumpkin are simple, alternating, and shallowly lobed, with white dots along the veins. The peduncle (the stalk that supports the fruit) is five-angled, expands toward the outside, and is linked to the fruit. Fruits (officially known as *pepo*) are rather big, varying in form from globose to rectangular to flatter. Their seeds are of 16-20 mm lenght and germinate 5-7 days after seeding. It is now extensively scattered over the world. It is claimed to be among the most commonly grown *Cucurbita* in the American tropics. C. *moschata* is a di-cotyledonous plant with a succulent soft hairy stalk. It is a yearly vine that grows to 3 meter's and produces fruits and flowers containing many seed's. The leafy parts of pumpkin are simple, alternating, and superficially lobed, with white dots across the veins that run through them. The peduncle (the stalk that supports the fruit) is 5-angled, expands radiating outwards, and is linked to the fruit.

Fruits (officially known as pepos) are rather big, varying in form from globose to rectangular to flatter. Seeds measure 16-20 mm long and thrive in 5-7 days after seeding. They have a vast fibrous root system. Blooming occurs 35-60 days following initiation as well as is more or less constant. Pumpkin fruits are chosen when they are nearly ripe or fully developed, around 4-6 weeks after blossoming, and are collected in multiple cycles until the crop is finished, 90-180 days following planting (Jacob *et al*., 2011) [2]. A few farmers allow the fruits to mature in their farms for many weeks before collecting the seeds. Skin thickness differs however it is often smooth, supple, and resilient. The skin can be light to dark green or light to dark orange, while the pulp can range from brown to entirely white, brilliant orange to greenish light. It can be smooth, pleasant, and typically non-fibrous, with many ovate-elliptic seeds that have a yellowish white surface. In most regions of India, the summer and wet seasons are the best times to cultivate *Cucurbita*cae. The fruit of pumpkin develops in around 90-120 days (Kulkarni *et al*., 2020) [3], and the fruits are frequently left to mature on the plant to provide an extended period of storage.

Beneficial plants and natural remedies have long been utilized in underdeveloped nations, and there is evidence of a comeback in the United States and Europe. It is extensively used in several systems of traditional medicine for the treatment of several disorders such as anti-inflammatory, anti-diabetes, anti-tumor, anti-hypertensive, anti-bacterial, anti-hypercholesterolemia, and intestinal anti-parasitic (Lestari *et al*., 2018) [4]. Pumpkin contains para-aminobenzoic acid, polysaccharides, lipids, sterol, peptides and proteins, all of which act as biological elements. The entire global output of gourds, squashes and pumpkins is 24.62 million metric tons from an area of 5,10,000 hectares, with India producing 49,00,000 tons for the year. The average measurement of a pumpkin is from 8 to 10 kg, but it may occasionally exceed 20 kg. Pumpkin serves as one of the greatest providers of phytochemicals and an excellent source of biologically active elements, including zeaxanthin, vitamin E, linoleic acid, carotenoids, selenium, phytosterols and ascorbic acids which serve as antioxidants in the body of a person (Sirohi *et al*., 2022) [5]. Pumpkin offers a wide range of economic applications, including puree, jam, sauces, jelly, chutney, marmalades, pies, and drinks, cookies and weaning mix, pies, (Dhiman *et al*., 2009) [6]. Beverages made from the pulp of pumpkin or juice are an essential savory preparation for consumers as they contribute to calming thirst in mid-August (Ziadi *et al*., 2014) [7] and are advertised beneath an array of identities including breakfast drink, fruit drink, squash, spiced squash, ready-to-serve (RTS), squash, nectar (Kumar *et al*., 2013) [8].

1.2 Nutritional Composition of Pumpkin

A number of investigations have focused on the nutritive and chemical composition of pumpkins: in different varieties of the same species, in different species of pumpkins and in different parts of pumpkins. Based on research done by Hashash *et al*. (2017) [9] in Egypt using C. *pepo* L. fruits, fruit pulp and seed, they have reported the proximate nutritional composition, mineral composition and antioxidant activity of each fruit part. According to the results obtained by their study, carbohydrate content of all three parts were considerably high and valued to be 14.51, 9.22 and 10.93% in fruit flesh, pulp and the seeds, respectively. And also, moisture contents of fruit pulp and flesh were reported as higher than 70% where in the seeds, the moisture content was relatively less as 5.63%.

Table 1: Nutritional Composition in parts of different species of Pumpkin

Nutrient's	Part	Cucurbitacae Species		
		C. *pepo*	C. *moschata*	C. *maxima*
Carbohydrate	Flesh	26.22	43.29	133.43
	Peel	43.76	96.29	206.78
	Seed	122.20	140.19	129.08
Fiber	Flesh	3.72	7.41	10.88
	Peel	12.28	34.28	22.35
	Seed	148.42	108.51	161.54
Fat	Flesh	0.55	0.89	4.20
	Peel	4.71	6.59	8.99
	Seed	439.88	456.76	524.34
Protein	Flesh	2.08	3.05	11.31
	Peel	9.25	11.30	16.54
	Seed	308.83	298.11	274.85
Ash	Flesh	3.44	10.36	10.53
	Peel	6.30	12.96	10.80
	Seed	55.02	53.15	44.22
Moisture	Flesh	967.70	942.31	840.43
	Peel	935.98	871.86	756.79
	Seed	74.06	51.79	27.51

Source: Nutrition Research and Practice 2012 [11]

In addition to these, fat and protein contents of seeds have been reported to be the highest values as 34.4 and 41.5%, respectively. The reported values by this study have given a clear vision regarding the role of pumpkins in addressing different dietary concerns. According to this study, mineral analysis of different fruit parts has also been done, and seeds have been reported to be the best source of minerals compared to the fruit pulp and the flesh. In the β carotene analysis, fruit flesh and pulp have reported the highest values as 37.83 and 34.75μg/g respectively. This has confirmed the use of pumpkin fruit flesh as a promising antioxidant agent. Several nutritional and phytochemical analysis have reported the composition of different parts of pumpkin fruit for their high protein content, Vitamin A, E and C content, phenolic content, β carotene content, crude fiber contents, minerals, fat content and carbohydrate content. According to Hussain *et al.* (2021) [10] pumpkins are considered as a good source of calories due to their high carbohydrate content. And also, this study has reported that high amount of protein and mineral in pumpkin makes it an important source of proteins and minerals like iron, magnesium, sodium, potassium. Pumpkins are rich in β carotene, which gives its characteristic yellow orange color, and is the main precursor of Vitamin A that makes pumpkin a rich source of Vitamin A. Pumpkin provides range of essential nutrients. Many studies have suggested that eating pumpkin reduces the risk of various diseases. People should incorporate this in their diet for maximum health benefits.

2. Phyto-chemistry of Pumpkin

2.1 Fruits: Pumpkins have a lower fat content (2.3%), carbs (66%), and proteins (3%) (McGinley *et al.*, 2011) [12], and a high carotenoids concentration (171.9 to 461.9µg/g). The value of food per 100 g is: 82kcal, 12.46% crude fiber, and 17% ash. According to Carvalho *et al.* (2014) [13], the analysis of minerals in the pumpkin pulp indicates high levels of Fe (1.368 mg kg^{-1}), Mn (0.495mg kg^{-1}), Cu (4.09mg kg^{-1}), Na (158.75mg kg^{-1}), P (11.367mg kg^{-1}), Ni (0.49mg kg^{-1}), Pb (0.288mg kg^{-1}),Mg (191mg kg^{-1}), Ca (169mg kg^{1}), and K (159mg kg^{-1}). The level of Cu (2-5mg kg^{-1}) and Pb (0.21-0.25mg kg^{-1}) are in the permissible range according to FAO (WHO, 1993) [14].

2.2 Seed: Pumpkin seeds can be eaten in two forms: roasted or uncooked, and are utilized as a component in bread, cereals, salads and cakes. Seed oil of pumpkin is regarded as both, a nutraceutical and an edible oil. Pumpkin seeds and their oil contain high in phytosterols (Philips *et al.*, 2005) [15], polyunsaturated fatty acid, proteins, (Sabudak *et al.*, 2007) [16], antioxidants, carotenoids, tocopherols, vitamins (Stevenson *et al.*, 2007) [17], and many other nutrients (Glew *et al.*, 2007) [18]. Because of the abundance of these elements, pumpkin seeds are thought to provide multiple benefits for health. Oil in the seed is present with the main components of fatty acid like palmitoleic (C 16: 1, 0.58%), palmitic acid (10.68%), gadoleic (1.14%), stearic acid (8.67%), linoleic (39.84%), oleic (38.42%), linolenic (0.68%), among which total saturated fatty acids are 19.35%, and total unsaturated fatty acids are 80.65% (Smith *et al.*, 1997) [19].

Pumpkin seed also contains variety of components such as γ-aminobutyl acid, p-aminobenzoic acid, polysaccharides, proteins, peptides, carotenoids as lutein epoxide, lutein, 13(13')-cislutein, 9(9')-cis-lutein, 15-cis-lutein (central-cis)-lutein, α-carotene, auroxanthin epimers, β-carotene, violaxanthin, flavaxanthin, chrysanthemaxanthin, α-cryptoxanthin, luteoxanthin, β-cryptoxanthin (Rabrenovic, *et al.*, 2014) [20]. Spina sterol and β-sitosterol accounted for 41.1 to 53.6 g per 100 g of sterol in total composition. Matus *et al.* (1993) [21] found that the third dominant sterol is Δ7-stigma-sterol, having 12.5-20.3 g per 100 g, and Δ7.25-stigma-stadienol, containing 5.8-8.0 g per 100 g of total sterol composition. The highest amounts of squalene in seeds ranges between 583.2 to 747 mg/100 g. Squalene' is a tri-terpene generated by humans, plants and animals that serves as a precursor for the manufacture of steroid hormones, vitamin D and cholesterol in the human body. Squalene' is also a chemical that has been shown to help cure some forms of cancer (Matus *et al.*, 1993) [21]. Additionally, the insides of the seeds possess cucurbitosides F-M. cucurbitosides and acylated phenolic glycosides (Li *et al.*, 2005) [22].

3. Bio-chemical characteristics of Pumpkin Seed and Kernel

The chemical composition of pumpkin seeds (whole pumpkin seed and kernel) was estimated using the Association of Official Analysis Chemist's (AOAC, 2000) [23] suggested technique, which included the proportions of ash, moisture, crude protein, crude fat, crude fiber, and carbohydrates. To evaluate the moisture content of the seed, the sample was weighed and processed to a uniform weight in an HAO (hot air oven) at 106±1°C. The Micro-Kjeldahl technique was used to quantify the proportion of nitrogen, and the crude protein concentration was calculated through multiplying it by 6.25. To determine the sample's ash composition, it was first burned on a steady flame burner and fired in a muffle furnace at 555ºC till light grey ash appeared (approximately 3 to 7 h). Gravimetric analysis was used to assess the fat content after the solvent had evaporated. To get the total carbohydrate amount, remove the total (crude fat + crude protein+ ash + crude fiber) value from 100.

The phytic acid content of flaxseeds was measured using the technique published by Lolas and Markakis (1975) [24]. Each analysis was done in triplicate, and the average findings are reported. To examine the free-fatty acid content of pumpkin seed oil, a gas chromatography (GC) plot was used. Christie (1992) [25] described a process for producing fatty acid methyl esters (FAMES). The free fatty acid profiles were evaluated at SICART, Sardar Patel University, VV Nagar. Inorganic compounds were analyzed. The material was digested wet with a diacid combination.

Table 2: Chemical composition of pumpkin seed and kernel

Composition	Mean value ± S.D.	
	Whole Pumpkin Seeds	**Kernel**
Moisture%	4.93	3.93
Crude fiber%	4.59	4.27
Crude fat%	31.75	37.29
Crude protein%	27.90	30.98
Phytic acid%	1.859	1.547
Total Carbohydrate% (by difference)	27.76	33.11
Ash%	6.91	2.36

Source: Devi *et al.,* 2018 [26]

Entire seeds of pumpkin had a greater amount of moisture (5.53±0.26%) compared to kernels (4.43±0.44%). The moisture content results have been determined to be consistent with prior research published by Al-Anoos *et al.* (2015) [27]. The kernel' contains more crude fat, protein, and total carbohydrate than entire pumpkin seeds. The carbohydrate, protein, ash, and crude fat amounts found in the present investigation are reliable with those published by and Steiner-Asiedu *et al.* (2014) [28]. The percentage of fat was considerably lower than that reported by Alfawaz (2004) [29]. Crude fiber levels were consistent with those reported by Al-Anoos *et al.* (2015) [27] but somewhat lower than those recorded by Karanja *et al.* (2013) [30]. The entire pumpkin seed had more phytic acid than the kernels. Nevertheless, there could possibly be minor variations in composition according to atmospheric stress, meteorological circumstances, geographical location, cultivation, and harvesting methods.

4. Medicinal Properties of Pumpkin

4.1 Anti-oxidant and free radical scavenger: Cellular destruction or oxidative damage, which is caused by the buildup of harmful free radicals are currently accountable for a variety of problems with human health, including diabetes, autoimmune pathologies, viral infections, digestive system diseases, neurodegenerative disorders and inflammation (Yadav *et al*., 2010) [31] Environmental substances, such as xenobiotics, endogenous compounds, and normal bodily processes all produce free radicals. Tocopherol's are non-glycosidic molecules found in vegetable oil that are known as natural antioxidants (Bharti *et al*., 2013) [32]. Pumpkin seed oil has δ and β-tocopherol isomers ranging between 29.9 to 53.59mg/100 g, accounting for 79% and 84% of the total tocopherol content, respectively (Matus *et al*., 1993) [21]. The anti-oxidant capacity of the seeds of pumpkin in extract made from methanol was measured utilizing free radical DPPH scavengers and soybean-lipoxygenase inhibitors. The EC 50 values for scavenging action on the DPPH radical test were 5.57mg ml^{-1}. Furthermore, the extract of methanol suppresses half of LOX activity at doses ranging between 0.3 to 1.02mg ml^{-1} [Xanthopoulou MN]. These extracts have a greater concentration of phenolic chemicals. The overall content of phenol determines the radical scavenging behavior. Nevertheless, there is no link amongst lipoxygenase inhibition and phenol concentration.

Another research investigation found that methanol seed extracts of cultivars such as jejuna and Miranda, the two of which pertain to the species C. *pepo*, had greater overall poly-phenol content, at 82.3mgGA/100g and 113mgGA/100g, correspondingly. In this work, the antioxidant capacity from C. pepo was also assessed. The hydrophilic form had the maximum range of 0.44 to 1.22um Trolox/gFW, whereas the lipophilic form had the lowest range of 3.33 to 0.1 TEAC. The FRAP test shows a maximum antioxidant effect of 1.83mol/100g FW. Pumpkin complex carbohydrates with various degrees of replacement were phosphor-rylated with POCl3 and pyridine. The antioxidative efficacy of phosphor-rylated polysaccharide's was assessed via measurements of reducing power, free radical-DPPH, reducing power, H_2O_2-induced oxidative damage and superoxide anion radical scavenging activity on rat thymic lymphocytes. All of the phospho-rylated polysaccharide derivatives' tested demonstrated elevated antioxidative actions in both in vitro and cell system. This is because high phosphor-rylated derivatives' contain e^- donating group, which are efficient of replacing free radicals into stable compound. This suggests that linked moieties across the top and bottom portions of e^-donating groups can link via an adverse relationship with allosteric sites. In experimental models, pumpkin polysaccharide outperforms unmodified polysaccharide in terms of cytoprotection, demonstrating that modifying it chemically may improve the cyto-protective effects.

4.2 Hepato-protective effects: The liver-protective properties effect of a protein derived from C. *pepo* seeds on Sprague-Dawley rat hepatic damage produced by acetaminophenol was investigated by measuring serum transaminases such as aspartate amino transferase (AST) and serum alanine amino transferase (ALT). The substantial rise in plasma ALT and AST levels is due to acetaminophen intoxication in the liver and kidney, as well as cellular enzyme leakage entering the circulation as a result of the damage. The treatment with C. *pepo* seed protein isolates extensively lowers the concentrations of AST and ALT. Furthermore, protein extracted from seed has an efficient antioxidant impact as demonstrated by chelating action, antixanthine oxidase characteristics, and free radical scavenging activity (Nkosi *et al*., 2006) [33]. A separate study investigated the impact of a protein extracted from C. pepo seeds on CCl4-induced damage in rats fed an inadequate protein diet. The delivery of this protein resulted in a substantial rise in the antioxidant enzymes (Nkosi *et al*., 2006) [33]. These investigations found that C. *pepo* seeds had the capacity to lower numerous parameters related with liver damage.

4.3 Anti-hyperglycemic: Diabetes is a condition of the metabolism that is a major issue in today's culture owing to the substantial health issues it causes. Pancreatic β-cells produce insulin, which regulates glucose levels (Sesti *et al.*, 2006) [34]. The primary cause of diabetes is incorrect insulin usage, which results in resistance from insulin, which is defined as the inability of cells to circulate a normal quantity of insulin to the body, causing glucose metabolism disruptions from normal functioning. Therapeutic aims should provide long-term glycemic control in diabetics. As a result, various herbal remedies have been shown to be beneficial in the long-term treatment of type II diabetes' mellitus. Raw pumpkin seeds include tocopherol isomers (α, γ, β, and δ), which have been shown to have antioxidant properties that can help manage diabetes.

According to the recent researches, the bioactive component in *Cucurbita moshata* is identified to be a polysaccharide (Zhang, *et al.*, 2004) [35]. In non-constraint docking, each tocopherols interacted with the most active areas of the proteins (Bharti *et al.*, 2013) [32]. A considerable reduction in oxidative indicators, as well as improved ceacal and pancreatic features, was found. However, additional investigation is needed to determine whether this is applicable to each member of the family. In alloxan-induced diabetic rats, polysaccharides in water extract pumpkin exhibit stronger hypoglycemic effects than glibenclamide (GB) (Zhang *et al*., 2004) [35]. Furthermore, pumpkin fruit contains significant quantities of pectin, a fiber that is taken to minimize the demand for insulin and regulate the level of glucose (Guillon *et al.*, 2000) [36]. However, protein-bound polysaccharide found in pumpkin lower blood glucose levels and enhance glucose tolerance (Caili *et al*., 2005) [37]. The isolated polysaccharide was structurally characterized as an acid hetero-polysaccharide (Mw=27 kDa) including Ara, Gal, Glc, and GalA in a ratio of 2.6:3.6:2:1 exhibiting a α-configuration. The structural framework is formed of (1 → 5)-linked Ara, (1 → 6)-linked Gal with three branches joined to O-3 of (1 → 6)-linked Gal and finished via either Gal or Gal and Glc. All of Glc and the bulk of GalA are organized in branches (Tong *et al*., 2008) [38]. This polysaccharide (50 mg/kg) is provided orally to alloxan-induced diabetes mice and improves body weight, decreases water consumption, and levels of glucose in the blood when compared to the diabetic placebo group.

Another study on alloxan-induced diabetic rats found that polysaccharide from pumpkins has a hypoglycemic impact (Xiong *et al*., 2001) [39]. Moreover, the treatment of fruit powder for a month in diabetic rats dramatically lowered cholesterol, CRP, glucose, and triglycerides while increasing insulin in diabetic rats (Sedigheh, *et al.,* 2011) [40]. The aqueous extract of pumpkin fruits contained 41.21% carbohydrates and 10.13% protein. The injection of these protein-bound polysaccharides to alloxan-induced diabetic rat models resulted in considerable glucose reduction (Shan *et al.,* 2009) [41]. Each of these investigations show that polysaccharides and protein-bound polysaccharides in pumpkin are functional agents for diabetes prevention. In a clinical investigation, thirty T2DM diabetic patients were given pumpkin polysaccharide granules for four weeks. After therapy, both urine and plasma glucose levels decreased (Shi *et al.,* 2003) [42].

South Africans employ many plants to cure type II diabetes, including C. *pepo*, which has been tested for α-glucosidase and α-amylase activity in vitro. The outcomes showed a blocking effect over both enzyme frameworks, supporting the traditional usage in the treatment of type II diabetic postprandial hyperglycemia (Baoduo *et al.,* 2014) [43]. C. *pepo* may thus be effective in the prevention and control of diabetic problems, given that its conventional use in diabetes is well known.

4.4 Anti-ulcer activity: A *Cucurbitaceae* metabolite was obtained from a methanol extract of powdered C. *pepo* seeds, and it demonstrated dose-related antiulcer efficacy, reducing the ulcerative index and demonstrating the compound's potential to protect the stomach mucosa (Gill *et al*., 2011) [44].

4.5 Prostatic-hyperplasia (BPH) and urinary function: BPH i.e. Benign prostatic hyperplasia is triggered by the steady expansion of the prostate gland, which is positioned at the base of the bladder and envelops the urethra. Because an enlarged prostate impacts the urethra, BPH is associated with reduced urine function (Gossell *et al*., 2006) [45]. Consumption of pumpkin seeds aids in the treatment of this condition, implying that the activities of seeds of pumpkin oil may be due to the presence of phytosterols. The enzyme 5α-reductase converts testosterone into a powerful androgen that promotes prostate gland development. This androgen is essential in the treatment of BPH. Inhibiting dihydro-testosterone lowers prostate development. In a double-blind, placebo-controlled study conducted over a three-month period, curbicin was isolated from C. *pepo* seeds and used to treat individuals with signs and symptoms of prostatic hyperplasia. The curbicin dose given to 55 individuals was 160 mg of standardized extract of C. *pepo* (80 mg). Micturition timing, urinary flow, frequency, and residual urine all improved markedly after curbicin administration (Carbin *et al*., 1990) [46].

In another trial, 45 patients with urinary dysfunction (overactive bladder, OAB) were administered orally with C. máxima seeds oil (10 g/day) for 12 weeks. Oil supplementation considerably decreased the degree of OABSS in patients (Nishimura *et al.,* 2014) [47]. OABSS, a self-assessment of OAB symptoms, is a common instrument for diagnosing and assessing the severity of OAB, and it is frequently utilized in clinical investigations (Homma *et al.*, 2006) [48].

Additionally, pumpkin seed oil (10%) was tested on citral-induced BPH in Wistar rats. Citral caused a considerable rise in prostate weight. However, seed oil effectively controlled enlarged prostate, decreased protein binding prostate (PBP) levels, weight of ventral prostate size, and improved testicular histology. Thus, it suggests that seed oil may be effective in the treatment of moderate benign prostatic hyperplasia (Abdel *et al.,* 2006) [49]. These findings showed that oil from pumpkin seeds might be used to generate novel chemotherapeutic drugs for the prevention or inhibition of benign prostatic hyperplasia.

4.6 Anti-microbial activity: Antimicrobial chemotherapy has transformed modern medicine, drastically reducing death and illness due to infectious infections. Nonetheless, microbes have acquired resistance to these antibiotics, reducing the efficacy of prior successful dosing regimens. Certain bacteria can secrete an extracellular polymer coating (bio-film) that accumulates and covers the bacterial cells while resisting antibiotics. germs in biofilms are more resistant to various antibiotics compared planktonic germs. Most antibiotics have weak intrinsic penetration and preservation. As a result, there is a strong interest in the discovery of new bioactive compounds. Infections produced by multidrug-resistant and pan drug-resistant bacteria are frequently difficult to treat due to limited treatment alternatives.

Nowadays, there has been a lot of interest in natural antimicrobial compounds in the hopes that they can give useful insights into antibacterial medication possibilities. C. *pepo* leaf extracts exhibited the broadest spectrum of action against *Pseudomonas aeruginosa, Providencia stuartii, K. pneumoniae, Enterobacter aerogenes, Escherichia coli* and *Enterobacter cloacae*. On at least one of the studied MDR bacteria, the C. *pepo* extract outperformed chloramphenicol, which served as a control that was positive. In most bacteria studied, chloramphenicol potency increased when PAβN was present. The extract from C. pepo leaves had the best MBC spectrum, with values ≤ 10^{22} μg/ml reported on 58.62% (17/29) of the investigated microorganisms (Noumedem *et al*. 2013) [50]. In a separate investigation, the methanol-based extract of the fruit of C. *pepo* was examined for its antimicrobial effects in opposition to bacterial strains *Bacillus subtilis, Bacillus cereus, Enterobacter aerogenes, Escherichia coli, Enterobacter agglomerans, Salmonella enteritidis, Staphylococcus aureus, Salmonella cholerasius, Pseudomonas aeruginosa, Penicillium chrysogenum, Candida albicans, Klebsiella pneumonia, Enterobacter faecalis, Klebsiella pneumonia.* The extract shown medium to significant efficacy towards every strain of bacteria tested (Dubey *et al*. 2010) [51].

4.7 Anticancer/antitumor effects: Cancer is considered to be one of the most serious health concerns in the world. Cancer claims around 12% of all deaths worldwide. Cancer treatment options include surgery, chemotherapy, and radiation. However, chemotherapy has disadvantages such as drug resistance, toxicity, side effects, and a lack of selectivity for tumor cells (Asif *et al.*, 2017) [52]. As a result, using plants as a prospective means of obtaining more effective anticancer medications is becoming increasingly important. Currently, over 40 *Cucurbita*cin-derived compounds and *Cucurbita*cins have been identified in the *Cucurbitaceae* family and other plant species. *Cucurbita*cins' apoptotic effects are caused by their capacity to change genes, transcriptional activity via nuclear factors and mitochondrial transmembrane potential, as well as their ability to activate or inhibit pro- or anti-apoptotic proteins. *Cucurbita*cins are specifically targeted inhibitors of the JAK/STAT pathways; however, other mechanisms are involved in their apoptotic effects, such as PARP cleavage, expression of active caspase-3, MAPK pathway, decreased JAK3 and pSTAT3 levels, and decreases in various downstream STAT3 targets such as Bcl-2, Mcl-1, cyclin D3, and BclxL, all of which are involved in cell cycle control. *Cucurbita pepo* alcohol extract had IC50 values of 132.6 and 167.2 µg/ml against cancer cell lines HepG2 and CT26, respectively. The ethanol-based extract of C. pepo fruits was shown to have a strong dependent on the dose inhibitory impact on HeLa cell proliferation (Shokrzadeh *et al.*, 2010) [53].

*Cucurbita*cins, found mostly in the *Cucurbitaceae*, are highly oxidized tetracyclic triterpenoids with the bio-genetically unique 10α-cucurbit-5-ene (10 →19β) abeo-10αlanostane skeleton. They are recognized for their cytotoxic effect. The ethanolic extract of air-dried C. pepo fruits was chromatographed to yield *Cucurbita* glycoside A and B. In vitro, both compounds have mild cytotoxic action against HeLa cells, with IC50 values of 17.2 and 28.5µg/ml (Wang *et al.*, 2008) [54].

Feng *et al*. (2007) [55] discovered that C. pepo cv. dayangua contains 23, 24-dihydro*Cucurbita*cin F, 23, 24-dihydro*Cucurbita*cin D, *Cucurbita*cin B, and *Cucurbita*cin E. The anti-proliferative action of 23, 24-dihydro-*Cucurbita*cin F on human PCa cells may be attributed to the activation of cofilin-actin rod formation and actin accumulation, which leads to cell decreased cell growth cycle arrest at G2/M phase, cytokinesis failure, and death. Furthermore, 23, 24-dihydro*Cucurbita*cin F inhibits Epstein-Barr virus (EBV) activation produced by the tumor promoter, 12-O-tetradecanoyl-phorbol-13-acetate (TPA), and it has significant anti-tumor promotion effect on mice epidermis tumor development (Konoshima *et al.*, 1994) [56]. *Cucurbita*cin E and *Cucurbita*cin B from C. *pepo* dayangua have been presented to be antiproliferative in breast (MCF-7), brain (SF-268), colon (HCT116), brain (SF-268), lung cancer cells (A549), and lung (NCI-H460) cancer cell lines, with *Cucurbita*cin B inhibiting proliferation by over eighty per cent (Jaya prakasam *et al.* 2003) [57]. *Cucurbita*cins E and B inhibited proliferation in malignancy cell lines (MDAMB-231 and MCF-7) while also inducing apoptosis and cell cycle arrest (Sun *et al.*, 2005) [58]. They also altered the amount of expression of cell-cycle regulatory proteins in both estrogen-independent (MDA-MB-231) and estrogen-dependent (MCF-7) human breast cancer cell lines. They further altered the amount of expression of cell-cycle regulatory proteins in both estrogen dependent (MCF-7) and estrogen-independent (MDA-MB-231) human breast cancer cell lines (Sun *et al*., 2003) [58]. *Cucurbita*cin B inhibited growth and had a harmful impact on breast cancer cell lines SKBR-3 and MCF-7 due to apoptosis and G2/M phase arrest. *Cucurbita*cin B administration reduced Cyclin D1, c-Myc, and β-catenin expression and translocation to the nucleus of β-catenin and galectin-3. Western blot examination revealed increased PARP cleavage, indicating caspase activity, and reduced mitogenic Wnt-associated signaling molecules galectin-3, β-catenin, c-Myc, and cyclin D1, along with alterations in phosphorylated GSK-3β levels (Dakeng *et al.*, 2012) [59]. *Cucurbita*cin E disrupted the vimentin cytoskeleton and actin structure, inhibiting prostate cancer cells from developing (Duncan *et al*., 1997) [60]. Furthermore, *Cucurbita*cins inhibited endothelial cell differentiation, which was followed by an impairment of the tubulin microfilaments cytoskeleton and F-actin, normal mitogen-induced T-lymphocytes (Smith *et al.*, 2000) [61], and minimized cell motility, implying an anti-angio-genesis and anti-metastasis role (Duncan *et al.*, 1997) [60]. Furthermore, it can induce and sustain high lymphocyte proliferation rates (Smit *et al.*, 2000) [61]. These findings suggest that C. *pepo* extracts might be used as novel chemotherapeutic medicines to prevent or decrease the growth of tumors and malignancies.

4.8 Anti-Diabetic: It is one of the most prevalent diseases, affecting individuals of all ages. It is a metabolic condition in which the body fails to generate adequate amounts of insulin or fails to react effectively to insulin. Diabetes is divided into two distinct groups: Type I diabetes and Type II diabetes. Many studies show that pumpkin and pumpkin seeds have nutrients that reduce the blood's glucose levels. Many diabetics avoid pumpkin due to its high level of carbohydrates, despite the fact that it poses no immediate harm. In diabetic rats, pumpkin seeds and flax seeds were found to have combination hypoglycemic and antioxidant effects. Histopathological changes are characterized by increased CAT (Chloramphenicol acetyltransferase), SOD (superoxide dismutase) and GSH (Growth stimulating hormone), as well as reduced MDA. The increases in glucose, total lipid, triglycerides, and total cholesterol in plasma were significantly resistant (Makni *et al.*, 2010) [62]. It has been shown that oil extracted from pumpkin seeds reduces increased levels of the enzymes alanine aminotransferase (ALT) in plasma and aspartate aminotransferase in cooked food, hence reducing the possibility of diabetes incidence. It is ingested in regular meals and is possibly beneficial for reducing diabetes risk and problems (Makni *et al*., 2010) [62].

Protein extracted from many varieties of pumpkin seeds from the *Cucurbitaceae* family, including *Cucurbita moschata* has been shown to have a hypo-glycemic impact. The consequence of the tolerance to oral glucose takes a look when accomplished on rats, found that globulin became the abundant storage protein which calculated 295 milligram per gram dry matter computed and adept of causing a considerable fall in sugar levels in blood (88 to 137.80%) (Teugwa *et al.*, 2013) [63].

5. Value added products of Pumpkin

Various studies have been conducted to develop value-added products including dietary supplements and food additives using different parts of the pumpkin fruit.

5.1 Pumpkin pulp flour: In a study conducted by Malkanthi *et al.* (2020) [64], it was identified the effectiveness of using pumpkin pulp flour as a supplement in string hopper production. According to this study, different ratios of pumpkin pulp flour as 0, 5, 11 and 22% have been mixed with rice flour and through a sensory evaluation; consumer acceptability of these items were checked. As the study states, the best recipe of flour was when the 22% pumpkin flour incorporated item with 8.13 overall acceptability. And also, according to the results of the proximate analysis of this resulted product, it has confirmed that the supplementation of pumpkin pulp flour into rice flour has elevated the protein content, carbohydrate content, moisture content, crude fiber content, mineral composition and antioxidant compounds in the end product.

5.2 Snacks from Pumpkin Pulp Flour: Based on the study conducted in Sri Lanka by Arachchige *et al.* (2019) [65] extruded snacks were developed using pumpkin flour. Pumpkin flour is prepared by using high flesh and seeds containing pumpkin variety to receive a maximum flour yield. For the snack production they have used wheat flour, pumpkin flour, salt, onion powder and spices as the dry ingredients where vegetable oil, water and shortening flavor as the liquid ingredients. Extruded snacks were prepared by using the twin screw extruder and the final product was then packaged in aluminum coated PET (Polyethylene Terephthalate) according to the modified atmosphere packaging aspects.

5.3 Pumpkin Cake: A study which has analyzed the physicochemical properties of cake made by pumpkin flour was done (Bhat *et al*., 2013) [66]. According to this study pumpkin blended cakes was made by mixing different ratios of pumpkin flour as 5, 10 and 15% to substitute wheat flour content. During the proximate analysis of the end products, results reflected that the moisture content was increased in the end product, and it was highest in the sample with 20% pumpkin flour. Similarly, the mineral content, fiber content and protein content were higher in the supplemented cakes and the values were highest in the sample with highest pumpkin flour content. But results have shown that the lowest fat content and carbohydrate content were reported in this sample due to the replacement of wheat flour in them. Under this study, a sensory evaluation has been conducted and according to its results sample prepared with 5% pumpkin flour had the highest overall acceptability where the highest pumpkin flour supplemented cake had the lowest acceptability by the panelists.

5.4 Pumpkin seed flour: According to a study carried out by Mishra *et al.* (2019) [67] they have developed two Indian traditional recipes known as 'Halwa' and 'Mathri' using pumpkin seed flour instead of the conventional ingredient; wheat flour. And a sensory evaluation has been conducted in order to evaluate consumer acceptance. As a result, Mathri was identified as the most accepted item compared to Halwa by the participants. And the proximate analysis conducted for Mathri, has confirmed that the nutritional composition is higher in the end product resembling the higher nutrient composition in pumpkin seeds. Another study was conducted by Kumari, *et al*. (2020) [68] to identify the nutrient composition and the consumer acceptance of biscuits which has developed as a value-added product by incorporating germinated pumpkin seed flour in different concentration to wheat flour. Here they have incorporated 10, 20 and 30% of seed flour into wheat flour in biscuit production. During the sensory evaluation, all three types of biscuits have been accepted by the consumers at 'like very much' category. And also, the proximate analysis has confirmed that the elevation of the moisture content, mineral content, crude fiber, fat content, Vitamin C content and β carotenes in the end product in all three pumpkin seed flour supplemented biscuits where the total protein content and carbohydrate content have declined. As the reason for this result, they have stated that incorporation in flour of pumpkin seed, reduces the amount of wheat flour content in the biscuits which makes the reduction of proteins and carbohydrates, as wheat flour contains more proteins and carbohydrates than pumpkin seed flour.

Another study conducted by Khan *et al. (*2016) [69] has reported similar results as in the previous study where wheat flour has substituted by pumpkin flour in biscuit production. According to a study conducted by See *et al*. (2007) [70] the use of C. *moschata* fruit flour in bread making has been evaluated. And under this study they have supplemented different ratios of pumpkin flour as 5, 10 and 15% in bread production. According to the results of the proximate analysis and the physical property check in the end product, the moisture content of the bread has increased along with the crude fiber and minerals content. But the carbohydrate, protein and fat contents have reduced in the end product because wheat flour contains more fat, proteins and carbohydrates than pumpkin flour. Under this study, a sensory evaluation also has been conducted in order to identify the consumer acceptance for the developed bread types. According to the results of that, the highest score was received by the bread prepared with 5% pumpkin flour incorporation.

5.5 Pumpkin Flower as Dietary Supplement: In addition, another study was conducted by Toro-Velez *et al*. (2022) [71] reported the production of packaged pumpkin flowers of C. *pepo* and C. *moschata* as a dietary supplement. Under this study, they have tested two different packaging systems including passive and active modified atmosphere packaging (MAP) to identify the most effective packaging method that will ensure the quality and the nutritional composition of pumpkin flowers. According to the results of this study, around 27% of the packaged flowers were deteriorated by the end of the 5th day when packaged in both ways as active and passive MAP. According to the sensory evaluation conducted to identify the consumer acceptability of these developed products, fresh flowers received the highest ranking in the 'like very much' category where both packaged flowers were ranked in the 'moderately like' category.

5.6 Pumpkin Jam and Jelly: Another study which was conducted by Sanadarani & Prasadi (2018) [72] to extract pectin as a commercial product from C. *maxima* leftover portion has reported that physiochemical properties of the extracted pectin from different parts of pumpkin. Pectin extraction was done by acid hydrolysis method and the highest yield of pectin was extracted from the peel which was 2.91%, compared to the flesh and pulp parts of the fruit. According to the proximate analysis of the extracted pectin from pumpkin, the moisture content was reported within the acceptable level as below 12% where the ash content was lower in the pumpkin pectin than the level in commercially available pectin. Also, the solubility of the extracted pectin was observed to be almost similar to the solubility of commercially available pectin in cold water, hot water, cold alkali and hot alkali. Based on the results obtained from these experiments, the effectiveness of using the extracted pectin from pumpkin as a gelling agent and a thickener in jam and jelly production is estimated.

6. Conclusion

Pumpkins are commonly recognized as members of the *Cucurbitaceae* family, specifically the genus *Cucurbita*. It is widely used in traditional medicine to treat a variety of illnesses, including anti-inflammatory, anti-hypercholesterolemia, anti-tumor, antihypertensive, anti-diabetes anti-bacterial, and intestine anti-parasitic. From the study it can be concluded that pumpkins are thought to be a rich source of calories because of their substantial amount of carbohydrates. It is a rich source of phytonutrients, and biologically active compounds. Pumpkins are marketed under a variety of names, including morning drink, fruit drink, squash, spiced squash, ready-to-serve (RTS), and nectar. Moreover, pumpkin finds versatile applications in the food industry. It is used as an additive in products such as candy, weaning mix, corn grits, kheer, jam, crackers, and bread. However, careful consideration of processing methods (such as high temperature, pH adjustments, blanching, and drying) is essential to retain its color, texture, flavor, and carotenoid content. Incorporating pumpkin into our daily diet can enhance overall health and well-being. Its medicinal and biological potential makes it a valuable addition to our culinary choices.

7. Acknowledgement

We would like to thank Babasaheb Bhimrao Ambedkar University, Lucknow, India, for providing the necessary support to carry out this work.

8. References

1. Aziz AELAB, Kalek AELHH. Antimicrobial proteins and oil seeds from pumpkin (*Cucurbita moschata*). Nature and Science. 2011;9(3):105-19.
2. Valenzuela JN, Morales DJZJ, Infante GJA, Gutierrez AF, Hernandez CIL, Guzman RNE, Laredo GRF. Chemical and physicochemical characterization of winter squash (*Cucurbita moschata* D.). Notulae Botanicae Horti Agrobotanici Cluj-Napoca. 2011 May 30;39(1):34-40.
3. Kulkarni AS, Joshi DC. Effect of replacement of wheat flour with pumpkin powder on textural and sensory qualities of biscuit. International Food Research Journal. 2013 Mar 1;20(2):587.
4. Lestari B, Meiyanto E. A review: The emerging nutraceutical potential of pumpkin seeds. Indonesian Journal of Cancer Chemoprevention. 2018 Jul 3;9(2):92-101.
5. Siroh PS, Choudhury B, Kalda TS. Pumpkin'Pusa Vishwas' for tropical and subtropical growing.
6. Dhiman AK, Sharma KD, Attri S. Functional constitutents and processing of pumpkin: A review. Journal of Food Science and Technology. 2009 May;46(5):411.
7. Ziadi M, Gaabeb N, Mrabet A, Ferchichi A. Variation in physicochemical and microbiological characteristics of date palm sap (*Phoenix dactylifera*) during the tapping period in oasian ecosystem of Southern Tunisia. International Food Research Journal. 2014 Apr 1;21(2).
8. Kumar V, Chandra S, Yadav A, Kumar S. Qualitative evaluation of mixed fruit based ready to serve (RTS) beverage. Inter J Agri Engin. 2013 Apr;6(1):200-5.
9. Hashash MM, Sayed ELMM, Hady AAA, Hady HA, Morsi EA. Nutritional potential, mineral composition and antioxidant activity squash (*Curcurbita pepo* L.) fruits grown in Egypt. Inflammation. 2017;9(10):11-2.
10. Hussain A, Kausar T, Din A, Murtaza A, Jamil MA, Noreen S, *et al*. Antioxidant and antimicrobial properties of pumpkin (*Cucurbita maxima*) peel, flesh and seeds powders. Journal of Biology, Agriculture and Healthcare. 2021 Mar 31;11(6):42-51.
11. Kim MY, Kim EJ, Kim YN, Choi C, Lee BH. Comparison of the chemical compositions and nutritive values of various pumpkin (*Cucurbitaceae*) species and parts. Nutrition research and practice. 2012 Feb 1;6(1):21-7.
12. McGinley M. *Cucurbita* pepo. The encyclopedia of Earth. Edible medicinal and non-medicinal plants. Fruits; Springer: Amsterdam, The Netherlands, 2011, p. 2.
13. Carvalho LM, Smiderle LD, Carvalho JL, Cardoso FD, Koblitz MG. Assessment of carotenoids in pumpkins after different home cooking conditions. Food Science and Technology. 2014;34:365-370.
14. FAO/WHO(1993).Evaluation of Certain Food Additives and Contaminants. WHO Report series 837, Geneva,
15. Phillips KM, Ruggio DM, Ashraf-Khorassani M. Phytosterol composition of nuts and seeds commonly consumed in the United States. Journal of agricultural and food chemistry. 2005 Nov 30;53(24):9436-9445.
16. Sabudak T. Fatty acid composition of seed and leaf oils of pumpkin, walnut, almond, maize, sunflower and melon. Chemistry of Natural Compounds. 2007 Jul 1;43(4).
17. Stevenson DG, Eller FJ, Wang L, Jane JL, Wang T, Inglett GE. Oil and tocopherol content and composition of pumpkin seed oil in 12 cultivars. Journal of agricultural and food chemistry. 2007 May 16;55(10):4005-4013.
18. Glew RH, Glew RS, Chuang LT, Huang YS, Millson M, Constans D, *et al*. Amino acid, mineral and fatty acid content of pumpkin seeds (*Cucurbita* spp) and Cyperus esculentus nuts in the Republic of Niger. Plant foods for human nutrition. 2006 Jun;61:49-54.
19. Smith BD. The initial domestication of *Cucurbita* pepo in the Americas 10,000 years ago. Science. 1997 May 9;276(5314):932-934.
20. Rabrenović BB, Dimić EB, Novaković MM, Tešević VV, Basić ZN. The most important bioactive components of cold pressed oil from different pumpkin (*Cucurbita* pepo L.) seeds. LWT-Food Science and Technology. 2014 Mar 1;55(2):521-7.
21. Matus Z, Molnár P, Szabó LG. Main carotenoids in

pressed seeds (*Cucurbita*e semen) of oil pumpkin (*Cucurbita* pepo convar. pepo var. styriaca). Acta Pharmaceutica Hungarica. 1993 Sep 1;63(5):247-56.
22. Li W, Koike K, Tatsuzaki M, Koide A, Nikaido T. Cucurbitosides F− M, Acylated Phenolic Glycosides from the Seeds of *Cucurbita* p epo. Journal of natural products. 2005 Dec 26;68(12):1754-7.
23. AOAC (2000) Official Methods of Analysis of the Association of the Analytical Chemists. 17th Ed. Inc. Virginia, Washington DC, USA.
24. Lolas GM, Markakis P. Phytic acid and other phosphorus compounds of beans (*Phaseolus vulgaris* L.). Journal of Agricultural and Food Chemistry. 1975 Jan;23(1):13-5.
25. Christie WW. Preparation of fatty acid methyl esters. Inform. 1992;3(9):1031-4.
26. Devi NM, Prasad R, Palmei G. Physico-chemical characterisation of pumpkin seeds. International Journal of Chemical Studies. 2018;6(5):828-31.
27. Al-Anoos IM, EI-dengawy R, Hasanin H. Studies on chemical composition of some Egyptian and Chinese pumpkin (*Cucurbita maxima*) seed varieties. Journal of Plant Science & Research. 2015;2(2):1-4.
28. Asiedu SM, Ameyaw NP, Agbemafle I, Hammond SH, Debrah TK. Research Article Nutrient Composition and Protein Quality of Four Species of the Curcubitaceae Family. Advance Journal of Food Science and Technology. 2014;6(7):843-51.
29. Alfawaz MA. Chemical composition and oil characteristics of pumpkin (*Cucurbita maxima*) seed kernels. Food Science and Agriculture. 2004;2(1):5-18.
30. Karanja J, Mugendi BJ, Khamis F, Muchugi A. Nutritional composition of the pumpkin (*Cucurbita* spp.) seed cultivated from selected regions in Kenya.
31. Yadav M, Jain S, Tomar R, Prasad GB, Yadav H. Medicinal and biological potential of pumpkin: an updated review. Nutrition research reviews. 2010 Dec;23(2):184-190.
32. Bharti SK, Kumar A, Sharma NK, Prakash O, Jaiswal SK, Krishnan S, *et al*. Tocopherol from seeds of *Cucurbita* pepo against diabetes: Validation by *in vivo* experiments supported by computational docking. Journal of the Formosan Medical Association. 2013 Nov 1;112(11):676-90.
33. Nkosi CZ, Opoku AR, Terblanche SE. Antioxidative effects of pumpkin seed (*Cucurbita* pepo) protein isolate in CCl4-Induced liver injury in low-protein fed rats. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2006 Nov;20(11):935-940.
34. Sesti G. Pathophysiology of insulin resistance. Best practice & research Clinical endocrinology & metabolism. 2006 Dec 1;20(4):665-679.
35. Zhang YJ. Study on the hypoglycemic effects and extraction and analysis of pumpkin polysaccharide. Journal of China Jiliang University. 2004;15(3):0238-41.
36. Guillon F, Champ M. Structural and physical properties of dietary fibres, and consequences of processing on human physiology. Food research international. 2000 Apr 1;33(3-4):233-245.
37. Caili FU, Huan S, Quanhong LI. A review on pharmacological activities and utilization technologies of pumpkin. Plant foods for human nutrition. 2006 Jun;61:70-77.
38. Tong H, Liang Z, Wang G. Structural characterization and hypoglycemic activity of a polysaccharide isolated from the fruit of *Physalis alkekengi* L. Carbohydrate polymers. 2008 Jan 24;71(2):316-23.
39. Xiong X, Cao J. Study of extraction and isolation of effective pumpkin polysaccharide component and its reducing glycemia function. Chinese J Modern Application Pharmacy. 2001;18:662-4.
40. Sedigheh A, Jamal MS, Mahbubeh S, Somayeh K, Mahmoud RK, Azadeh A, *et al*. Hypoglycaemic and hypolipidemic effects of pumpkin (*Cucurbita* pepo L.) on alloxan-induced diabetic rats. African Journal of Pharmacy and Pharmacology. 2011 Dec 22;5(23):2620-2626.
41. Shan JJ, Ren FX, Tian GY. Structure characterization and hypoglycemic activity of a glycoconjugate from Atractylodes macrocephalae Koidz. Functional Plant Science and Biotechnology. 2009;3(1):36-41.
42. Shi Y, Xiong X, Cao J, Kang M. Effect of pumpkin polysaccharide granules on glycemic control in type 2 diabetes. Central South Pharmacy. 2003;1(5):275-276.
43. Boaduo NK, Katerere D, Eloff JN, Naidoo V. Evaluation of six plant species used traditionally in the treatment and control of diabetes mellitus in South Africa using in vitro methods. Pharmaceutical biology. 2014 Jun 1;52(6):756-761.
44. Gill NS, Bali M. Isolation of anti-ulcer *Cucurbita*ne type triterpenoid from the seeds of *Cucurbita* pepo.
45. Williams GM, Davis A, O'connor N. Inhibition of testosterone-induced hyperplasia of the prostate of sprague-dawley rats by pumpkin seed oil. Journal of Medicinal Food. 2006 Jun 1;9(2):284-286.
46. Carbin BE, Larsson B, Lindahl O. Treatment of benign prostatic hyperplasia with phytosterols. British Journal of Urology. 1990 Dec;66(6):639-641.
47. Nishimura M, Ohkawara T, Sato H, Takeda H, Nishihira J. Pumpkin seed oil extracted from *Cucurbita maxima* improves urinary disorder in human overactive bladder. Journal of Traditional and Complementary Medicine. 2014 Jan 1;4(1):72-74.
48. Homma Y, Yoshida M, Seki N, Yokoyama O, Kakizaki H, Gotoh M, *et al*. Symptom assessment tool for overactive bladder syndrome overactive bladder symptom score. Urology. 2006 Aug 1;68(2):318-323.
49. Abdel-Rahman MK. Effect of pumpkin seed (*Cucurbita* pepo L.) diets on benign prostatic hyperplasia (BPH): chemical and morphometric evaluation in rats. World J Chem. 2006;1(1):33-40.
50. Noumedem JA, Mihasan M, Lacmata ST, Stefan M, Kuiate JR, Kuete V. Antibacterial activities of the methanol extracts of ten Cameroonian vegetables against Gram-negative multidrug-resistant bacteria. BMC Complementary and Alternative Medicine. 2013 Dec;13:1-9.
51. Dubey A, Mishra N, Singh N. Antimicrobial activity of some selected vegetables. International Journal of applied biology and pharmaceutical technology. 2010;1(3):994-999.
52. Asif M, Naqvi RSA, Sherazi TA, Ahmad M, Zahoor AF, Shahzad SA, *et al*. Antioxidant, antibacterial and antiproliferative activities of pumpkin (cucurbit) peel and puree extracts-an in vitro study. Pakistan journal of

pharmaceutical sciences. 2017 Jul 1;30(4).
53. Shokrzadeh M, Azadbakht M, Ahangar N, Hashemi A, Saravi SS. Cytotoxicity of hydro-alcoholic extracts of *Cucurbita* pepo and Solanum nigrum on HepG2 and CT26 cancer cell lines. Pharmacognosy magazine. 2010 Jul;6(23):176.
54. Wang DC, Xiang H, Li D, Gao HY, Cai H, Wu LJ, *et al*. Purine-containing *Cucurbita*ne triterpenoids from *Cucurbita* pepo cv dayangua. Phytochemistry. 2008 Apr 1;69(6):1434-8.
55. Feng XS, Wang DC, Cai H, Deng XM, Liu YR. Determination of the *Cucurbita*cins from Cucubita pepo cv dayangua by HPLC. Zhong yao cai= Zhongyaocai= Journal of Chinese Medicinal Materials. 2007 Apr 1;30(4):418-20.
56. Konoshima T, Takasaki M, Tatsumoto T, Kozuka M, Kasai R, Tanaka O, *et al*. Inhibitory effects of *Cucurbita*ne triterpenoids on Epstein-Barr virus activation and two-stage carcinogenesis of skin tumors. Biological and Pharmaceutical Bulletin. 1994 May 15;17(5):668-71.
57. Jayaprakasam B, Seeram NP, Nair MG. Anticancer and antiinflammatory activities of *Cucurbita*cins from *Cucurbita* andreana. Cancer letters. 2003 Jan 10;189(1):11-16.
58. Sun J, Blaskovich MA, Jove R, Livingston SK, Coppola D, Sebti SM. *Cucurbita*cin Q: A selective STAT3 activation inhibitor with potent antitumor activity. Oncogene. 2005 May;24(20):3236-45.
59. Dakeng S, Duangmano S, Jiratchariyakul W, Pratya UY, Bögler O, Patmasiriwat P. Inhibition of Wnt signaling by *Cucurbita*cin B in breast cancer cells: Reduction of Wnt-associated proteins and reduced translocation of galectin-3-mediated β-catenin to the nucleus. Journal of cellular biochemistry. 2012 Jan;113(1):49-60.
60. Duncan MD, Duncan KL. *Cucurbita*cin E targets proliferating endothelia. Journal of surgical research. 1997 Apr 1;69(1):55-60.
61. Smit HF, Berg VDAJ, Kroes BH, Beukelman CJ, Ufford QVHC, Dijk VH, *et al*. Inhibition of T-lymphocyte proliferation by *Cucurbita*cins from Picrorhiza scrophulariaeflora. Journal of natural products. 2000 Sep 22;63(9):1300-2.
62. Makni M, Sefi M, Fetoui H, Garoui EM, Gargouri NK, Boudawara T, Zeghal N. Flax and Pumpkin seeds mixture ameliorates diabetic nephropathy in rats. Food and Chemical Toxicology. 2010 Aug 1;48(8-9):2407-12.
63. Teugwa CM, Boudjeko T, Tchinda BT, Mejiato PC, Zofou D. Anti-hyperglycaemic globulins from selected *Cucurbitaceae* seeds used as antidiabetic medicinal plants in Africa. BMC complementary and alternative medicine. 2013 Dec;13:1-8.
64. Malkanthi A, Hiremath US. Pumpkin powder (*Cucurbita maxima*)-supplemented string hoppers as a functional food. International journal of food and nutritional sciences. 2020 May;9(1):2.
65. Arachchige US, Dinali WA, Lankanayake HB, Madhubhashini MN, Marasinghe MA. Development of extruded snacks using pumpkin flour.
66. Bhat MA, Bhat A. Study on physico-chemical characteristics of pumpkin blended cake. Journal of Food Processing & Technology. 2013;4(9):4-9.
67. Mishra S, Pandey SL. Development and quality evaluation of value-added pumpkin seed products. Development, 2019 Feb 14.
68. Kumari N, Sindhu SC, Kumari V, Rani V. Nutritional evaluation of developed value-added biscuits incorporating germinated pumpkin seed flour. Journal of pharmacognosy and phytochemistry. 2020 May;9(5):2802-2806.
69. Khan MA, Mahesh C, Vineeta P, Sharma GK, Semwal AD. Effect of pumpkin flour on the rheological characteristics of wheat flour and on biscuit quality. Journal of Food Processing & Technology. 2019 Oct;10(9):1-6.
70. See EF, Noor Aziah AA, Wan Nadiah WA. Physico-chemical and sensory evaluation of breads supplemented with pumpkin flour. ASEAN Food Journal. 2007 Feb;14(2):123.
71. Vélez TK, Jáuregui CR, Beaver WL, Brunner B. Production and postharvest assessment of tropical pumpkin flowers harvested for consumption. HortTechnology. 2022 Apr 1;32(2):199-212.
72. Sanadarani MD, Prasadi VP. Value added products from agriculture: extraction of pectin from pumpkin (*Cucurbita maxima*) waste. Journal of food and industrial microbiology. 2018 Apr;4(4):1-3.