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A Review on Production of Pumpkin Seed Powder and its utilization in Bakery Product Development

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Abstract: The term "pumpkin" refers to a large group of Cucurbitaceae species, the majority of which have economic significance. The manufacturing of pumpkin seed powder using different drying methods, as well as its application in bread items to substitute wheat flour and fortify phytochemicals, were the main topics of this study of the literature. Color and sensory analysis were negatively impacted by raising the concentration of pumpkin flour, according to the study. According to the study, low to medium concentrations of pumpkin seed flour were found to be more palatable from a sensory perspective, and as a result, the sensory score decreased. Raising the amount of pumpkin seed powder in the baked goods raised their carotene content. Bakery product indicators were identified. On the technological indicators of baked items, the influence of pumpkin seed flour was identified. Since pumpkin seed flour has substantially larger particles than wheat whole meal flour, using it should have an impact on the mechanical and structural characteristics of both semi-finished dough products and final bakery goods. The present review is on the comparison of pumpkin seed powder with wheat flour in terms of water absorption capacity, nutritional composition, anti-carcinogenic properties, anti-oxidant effect, Anti-diabetic properties , Anti-microbial effects etc.

IndexTerms **- Pumpkin Seed powder, carotene content, phytochemicals, wheat substitution, bakery products , nutritional composition.**

I. INTRODUCTION:

Pumpkins are widely cultivated in tropical and subtropical regions. The yellow or orange hue of pumpkin is attributed to the high content of β-carotene. A significant supply of vitamin A is found in plants with a pleasant yellow-orange coloration, as β-carotene. Eating foods high in beta-carotene can help avoid skin conditions, cancer, and eye problems. The greatest approach to increase vitamin A nutrition and help each person overcome the issues and diseases caused by vitamin A deficiency is to incorporate foods high in β-carotene in their meals [1] .

In 2012, there were 25 million tons of pumpkins produced worldwide including by the small farmers and larger producers to meet local demand (Food and Agriculture Organization of the United Nations, 2012). The species also produces seeds that can be added to food items in addition to pulp. Pumpkin seeds are used in the East to make breads, cakes, and cereals ; pumpkin seeds are rich in fiber, a natural source of protein, and phytosterols, which can all improve human nutrition, physiology, and metabolism [2]. Edible pumpkin fruit kernels are called pepitas or pumpkin seeds. Hulled and lightly roasted pumpkin kernels are referred to as pepita in Central America. The seeds are semi-flat objects that usually have an oval form with a conical tip. The kernels within have a white outer hull, an olive-green tint, a sweet, buttery texture, and a nutty flavor. Cucurbita pepo, or pumpkin seeds, have drawn a lot of interest lately because of its nutritional significance and potential health advantages. They have an earthy flavor and may be found in many different recipes, including salads, soups, and baked snacks. They are an excellent source of fiber, minerals, carotenoids, proteins, calories, and phytosterols. They also include omega 3 and omega 6 fatty acids, which are essential

for healthy skin and brain function. Therefore, the goal of the research on using pumpkin seed flour in baked goods is to raise awareness through dietary instruction[4].

A vast variety of culinary items, including bread, biscuits, and cakes, contain wheat. Wheat flour, the primary ingredient used to make bakery and confectionery goods, has a trace quantity of β-carotene, which is regarded as precursor of vitamin A which is available in variety of fruits and vegetables . Therefore, the primary goal of this work was to appraise the effects of different proportions of pumpkin seeds flour addition, as a supplant to the wheat flour in bakery products[1,2].

Numerous studies have demonstrated a connection between the naturally occurring bioactive ingredients in food and the prevention and promotion of health problems. The foods that qualify this diet-health relationship are known as functional foods. Many functional food ingredients are derived from plants, which are natural sources of bioactive chemicals. Like other seeds, pumpkin seeds are full of useful parts. They are rich in proteins, phenolic compounds and their derivatives, coumarins, unsaturated fatty acids, flavonoids, pigments, pyrazine, squalene, phytosterols, triterpenoids, and vitamin E (tocopherols). Plants in the Cucurbitaceae family yield a variety of proteins and peptides from their seeds that control appetite and aid in weight loss. The body wouldn't function properly without such protein and amino acid sources and result in weakness [4,5] .

II. NUTRITIONAL COMPOSITION:

2.1 Study of nutritionally enriched biscuits made from whole pumpkin seed flour:

Biscuits that are made by utilizing whole pumpkin seed flour were tested. By decreasing the amount of pumpkin seed powder in biscuits, the width of biscuits decreases from 57 to 50 mm, the thickness increases from 11 to 15 mm and the spread factor of biscuits decreases from 51.81 to 33.5. The highest value of spread factor was found in the control sample. The color reading of biscuit shows that sample 1 and 3 have the highest L value that is these samples are the lightest in color among all biscuits. L value was increased by decreasing the amount of pumpkin seed flour. The highest +a value found in sample 2. It was also discover that decreasing the addition of pumpkin seed decreases the redness of the sample. The highest +b value found in sample 2 i.e. highest degree of yellowness. The wettability percentage of the product is shown in table 4. The wettability percentage of the product is increased from 0.83 to 0.95 by decreasing the amount of pumpkin seed. The values are listed in Table 1 below.

Table 1 : Physical parameters of Biscuits

Sample	Width(mm)	Thickness(mm)	Spread factor	Weight of cookies	Wet ability Percentage (%)
Sample 1	50±0.3	15±0.55	33.5±0.2	7.74±0.04	95±0.3
Sample 2	50.3±0.3	15±0.55	33.5±0.2	9.11±0.07	86±0.35
Sample 3	51.3±0.32	15±0.55	34.2±0.15	7.35±0.04	85±0.5
Sample 4 (control)	57±0.5	11±0.50	51.81±0.15	8.55±0.04	84±0.5

The table which consists of physical parameters of biscuits have been taken from [S. Das, M. Ghosh, and P. Chakraborty][77].

2.2 NUTRITIONAL COMPOSITION:

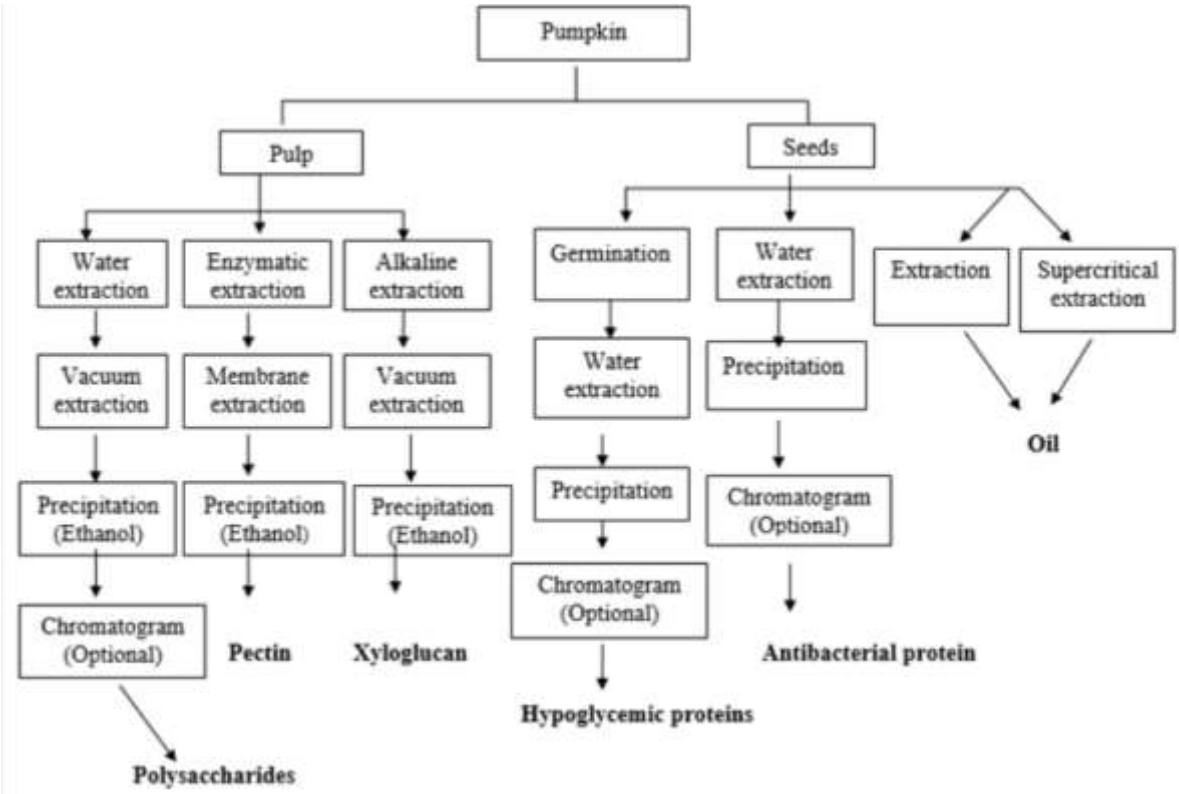

Figure 1 : Extraction of bioactive components from pumpkin seeds and pulp.

The flowchart which shows the extraction of bioactive components from pumpkin seeds and pulp have been taken from [Q. A. Syed, M. Akram, and R. Shukat][78].

Table 2 : Nutritional Values of Pumpkin seeds per 100g.

Components	**Nutritional Value**	**RDA %**
Carbohydrates	10.71 gm	8
Energy	559 Kcal	28
Total Fats	49.05 g	164
Protein	30.23 g	54
Fiber	6 g	16
Cholesterol	0 mg	0
Micronutrients (Vitamins)		
B_9 (Folic Acid)	58 micro gm	15
B_3 (Niacin)	4.8 mg	31.0
B_5	0.75 mg	15

B_1 (Thiamin)	0.272 mg	11
Vit C	0.272 mg	12
Vit A	16 IU	23
Vit E	35.1 mg	3.0
Major Minerals		0.50
Na^+	7 mg	272
K^+	809 mg	
Phytochemicals		
Beta Carotenoid	9 micro gm	----
Beta Crypto Xanthin	1 micro gm	---

The table shows the nutritional composition of pumpkin seeds per 100g have been extract from [Q. A. Syed, M. Akram, and R. Shukat][78].

2.3 Estimation of total phenolic compounds:

The quantity of total polyphenolic compounds in pumpkin seeds was priorly decided calorimetrically by using the Folin-Ciocalteu reagent, according to Francis (1982). Total polyphenol values were expressed in terms of Gallic acid equivalent mg/100g. The test was repeated in triplicate.

2.4 Estimation of total flavonoids:

The colorimetric process of aluminum chloride was used to analyze flavonoids (Aiyegoro and Okoh 2010). One milliliter (1 ml) of seeds (1 mg/ ml) was mixed with 0.2 ml of 10% aluminum chloride, 3 ml of methanol , 5.6 ml of distilled water and 0.2 ml of 1 M potassium acetate and remains for 30 min at room temperature. The absorption of the reaction mixture with a UV visible spectrophotometer was measured at 420 nm. The calibration curve was extrapolated to arbitrate the content by preparing a quercetin solution in distilled water. The concentration of flavonoids was expressed in terms of mg/100g.

2.5 Dietary fiber content:

Cookies with no added pumpkin seed powder had 1.06 per cent soluble, 7.44 per cent insoluble and 8.51 per cent total dietary fiber content. Incorporation of germinated pumpkin seed flour by replacing 10, 20 and 30 per cent of refined wheat flour, respectively, significantly ($P \leq 0.05$) increased the soluble as well as insoluble dietary fiber content. The respective composition of soluble, insoluble and total dietary fiber content of Type II cookies was 1.18, 8.23, 9.41 g/100g and for Type III cookies it was 1.24, 8.62 and 9.86 g/100g,

Table : 3 Diebatic fiber content of value added cookies incorporated pumpkin seed powder (per 100 g, dry basis)

Types of cookies	Soluble dietary fiber	Insoluble dietary fiber	Total dietary fiber
Control RWF:GPSP::100:0	1.06±0.03	7.44±0.07	8.51±0.21
TypeI RWF:GPSP::90:10	1.10±0.05	7.86±0.09	8.96±0.14
TypeII RWF:GPSP::80:20	1.18±0.09	8.23±0.11	9.41±0.13
Type III RWF:GPSP::70:30	1.24±0.11	8.62±0.12	9.86±0.17

Values are mean±SE of six independent observations

RWF: Refined wheat flour ; GPSP: Germinated pumpkin seed powder

The table has been extracted from [N. Kumari and S. C. Sindhu][79].

III. PROPERTIES

3.1 ANTI – CARCINOGENIC PROPERTIES :

One of the biggest health issues affecting individuals globally is tumours, which account for 12% of all deaths. It is the outcome of aberrant tissue mass expansion brought on by unbalanced, uncontrollably occurring cell division and death. It is stated that one of the main risk indicators used to determine the aberrant growth was a cell's capacity for antioxidants. One main cause of oxidative stress, which can lead to the growth of tumour or cancer cells, may be the imbalance between antioxidant defences and free radicals within cells, which leans toward the former. Radiation, surgery, and chemotherapy are among the treatment options [5]. Choosing preventative measures and therapeutical tactics to prevent and treat cancer is one of the largest challenges

facing investigators, experts, and researchers. It has been found that eating a diet rich in fruits and vegetables reduces the risk of developing cancer. Pumpkin seed-rich diets have also been linked to a decreased incidence of colorectal, breast, stomach, and lung cancers. The different carotenoid pigments in pumpkin seed oil have the potential to provide additional health advantages, such as anti-carcinogenic properties. Prostate cancer prevention has been associated with the carotenoids found in pumpkin fruits. Pumpkin fruit extracts have been shown to significantly lower tumour weight in S-180-bearing mice [5,6,7]. The proliferation of leukaemia K-562 cells was found to be inhibited by MAP2 (MW 2249 Da) and MAP4 (MW 4650 Da), two basic proteins that Cheong et al. isolated from pumpkin seeds. Furthermore, it has been discovered that other proteins from pumpkin seeds prevent the growth of melanoma. In the mature seeds of the pumpkin (C. moschata), Xia et al. isolated a novel ribosome-inactivating protein (RIP) known as moschatin. They also successfully prepared a novel immunotoxin called moschatin-Ng76, which effectively inhibits the growth of targeted melanoma cells M21 with an IC50 (50 percent inhibitory concentration) of 0·04 nM, 1500 times lower than that of free moschatin [8,9]. Using human breast cancer cells (MCF7) and human chorionic carcinoma cell lines (Jeg3 and BeWo), Richter et al. (2013) investigated the anticancer effect of pumpkin seed extract. The findings demonstrated a cytotoxic effect on those cancer cells and increased the production of estradiol in a concentration-dependent manner. Pumpkin seeds' biphasic action, which combines estrogenic and antiestrogenic properties through various pathways, is one explanation for this phenomena [Lestari et al., 2018]. [10]. Another in vitro finding was published by Medjakovic et al. (2016). They discovered that hydroalcoholic pumpkin seed extract had a lower effect on non-hyperplastic cells while inhibiting the proliferation of cancer and hyperplastic cells. They came to the conclusion that sex steroid hormone receptors did not mediate the anticancer activity of pumpkin seeds.

In order to evaluate the effects of ethanolic pumpkin seed extract in 1,2-dimethylhydrazine-induced colon cancer in Wistar rats, Chari et al. carried out an in vivo investigation [15]. They discovered that when cells were treated with 200 mg/kg extract, apoptosis was induced. The study went on to say that the extract is effective in treating tumours and is cytotoxic to malignant cells. Hydro-alcoholic pumpkin seed extracts have been shown to inhibit the growth of human hepatocarcinoma (HepG2) and colon carcinoma (CT26) tumour cell lines, according to a different study [16]. Additionally, Ren et al. showed that the pumpkin seed isolate cucurbitacin had a dose-dependent inhibitory effect on the proliferation of prostate cancer, while Jayaprakasam et al. [17,5] revealed antiproliferative action in breast, colon, and lung cancer cell lines [18].

A group of women who were at risk of cancer were fed pumpkin seeds and a meal frequency questionnaire was created. Upon completion of the research and consumption time, it was determined that pumpkin seeds are substantially linked to postmenopausal risks of breast cancer. et al. Zaineddin [3,13].

Some researchers contend that cucurbitacin, one of the active ingredients in pumpkin seed extract, has no role in the anticarcinogenic effects of pumpkin seeds, while others attribute the anticarcinogenic potential of pumpkin seeds to their flavonoid and cucurbitacin concentrations. This specific evidence is indisputable and suggests that additional pathways may be involved in the anticarcinogenic effects. This leaves space for additional isolation and analytical research to disprove the opposite [5].

3.2 ANTIOXIDANTS EFFECTS:

Numerous chronic diseases and their aftereffects, including diabetes, obesity, cardiovascular disease, and cancer, have been linked to oxidative stress as a characteristic. It is a situation where there is an imbalance that may be deleterious between pro- and antioxidant levels, with a tendency toward the former [6]. Pumpkin extracts from different parts have been shown to exhibit antioxidant activity, which may be important for people with vascular damage, diabetes, and pre-diabetes. In streptozotocin-induced diabetic rats, Xia & Wang [19] revealed a mechanism for the cytoprotective (cell-protecting) effect of pumpkin (fruit) extract by demonstrating both its hypoglycemic and antioxidant properties.

Tocopherol, an antioxidant found in high concentrations in pumpkin seeds, has been suggested as a major source of vitamin E in Japanese diets through the use of pumpkin seed oil [6,20]. According to the findings of several researchers, the total phenolic levels of pumpkin seed oil varied from 25 to 51 mg/kg. Vanillin, tyrosol, luteolin, sinapic acid, and vanillic acid were the phenolic concentrations. The maximum antioxidant capacity determined by Andjelkovic et al. [3,21] with the help of the DPPH radical's reduction was 62%.

Kosi et al. investigated the antioxidative potential of isolated pumpkin seed protein in rats maintained on a low-protein, weight-reduction diet for a period of five days. Rats exposed to acetaminophen intoxication were given the extracted protein from pumpkin seeds. The rats were killed 24, 48, and 72 hours following their specific treatment. The protein extracted from pumpkin seeds exhibited xanthine oxidase inhibition of roughly 10%, chelating activity of roughly 64% on Fe2+ ions, and radical scavenging activity of about 80%. As demonstrated by the higher antioxidant level and decreased level of lipid per oxidation, the use of isolated pumpkin protein increases the damage that CCl4 causes to the liver [22].

Bardaa et al. (2016) performed an in vivo investigation on cutaneous wound healing rats, and the results showed that oil extracted from pumpkin seeds using cold pressure performed better than the untreated group in macroscopic, morphometric, and histological data of rat skin. Elfiky et al. have demonstrated the powerful antioxidant impact and protective action of pumpkin seeds against genotoxic substances [24, 10]. (2012). It has been repeatedly and convincingly shown by these results that pumpkin seed oil is an effective antioxidant and free radical scavenger. Treatment with pumpkin seed oil reduced free radicals and was beneficial for arthritis, according to Fahim et al. (1995) [23].

According to Dang's research [25,6], giving mice pumpkin extract dramatically raised their levels of glutathione peroxidase and superoxide dismutase in their livers and serous tissues while also lowering their malonaldehyde concentration. Moreover, it has been discovered that pumpkin polysaccharide can lower the amount of malonaldehyde in tumor-containing mice blood and raise the activities of glutathione peroxidase and superoxide dismutase [26].

An investigator demonstrated that the anti-inflammatory and anti-oxidative properties of pumpkin seed oil shield the small intestine of rats against damage caused by methotrexate. Growth stimulating hormone (GSH) and its storage El-Boghdady are stimulated and increased when the oil is administered orally in combination with ellagic acid or pumpkin seed oil separately five days prior to methotrexate treatment. This reduces damage to the small intestine and increases levels of prostaglandin, tissue nitric oxide, GSH, malondialdehyde, xanthine oxidase, and adenosine deaminase. Furthermore, a study conducted by Yasir et al. (2016) revealed that pumpkin seed extract demonstrated genoprotective and antioxidant properties [10].

3.3 ANTI-DIABETIC ACTIVITY :

Diabetes mellitus is one of the most common conditions affecting the elderly population. Diabetes mellitus is a metabolic disease in which the body either produces insufficient amounts of insulin or responds improperly to the insulin that is generated. The two primary forms of diabetes are Type I and Type II diabetes[5]. Scientific researchers are under pressure to create novel, safer, and more affordable diabetic treatments due to the disease's high economic cost and steadily rising incidence worldwide. These conditions are met by herbal remedies. Consequently, a number of research have been carried out lately to determine the herbal formulations' capacity to prevent diabetes; one of them is pumpkin [28]. There are many researches that stated that pumpkin seeds and pumpkin contained components that lower the blood glucose level . Local healers recommend the ingestion of crude aqueous extract of pumpkin fruits for the treatment of type 2 diabetes or non-insulin-dependent diabetes mellitus [6,29] .

It has been established that the combination of flax and pumpkin seeds has hypoglycemic and antioxidant effects in diabetic rats [30, 31]. Histopathological changes are characterised by decreased MDA, increased GSH (growth stimulating hormone), SOD (superoxide dismutase), and CAT (chloramphenicol acetyltransferase) (malondialdehyde and antioxidant enzyme). According to Makni et al. [32], there was a significant lack of response to the increases in plasma levels of glucose, total lipid, triglycerides, and overall cholesterol.

Pumpkin exhibits hypoglycemic action similar to that of a common medication (tolbutamide), according to research by Xia & Wang [33] in both mildly diabetic and healthy mice with transient hyperglycemia, but not in severely diabetic animals. They proposed that these effects could result from either the release of bound insulin or via increased pancreatic insulin secretion from the current beta-cells.

Table : 4 Effect of pumpkin seeds powder and oil on organs/ body weight ratio in diabetic rats [33]

Parameter Treatment	Liver / BW ratio	Kidney/ BW ratio	Spleen / BW ratio
Negative control	3.22 ± 0.23 ^{ab}	0.96 ± 0.044 ^{a}	0.43 ± 0.035 ^{a}
Positive control	2.94 ± 0.24 ^{ab}	0.78 ± 0.046 ^{b}	0.39 ± 0.036 ^{a}
Dried pumpkin seeds powder 1%	2.68 ± 0.23 ^{b}	0.75 ± 0.043 ^{b}	0.39 ± 0.034 ^{a}
Dried pumpkin seeds powder 3%	3.46 ± 0.24 ^{a}	0.89 ± 0.046 ^{ab}	0.40 ± 0.036 ^{a}
Pumpkin seeds oil 1%	3.65 ± 0.26 ^{a}	0.83 ± 0.050 ^{ab}	0.50 ± 0.039 ^{a}
Pumpkin seeds oil 3%	3.33 ± 0.22 ^{a}	0.79 ± 0.053 ^{ab}	0.49 ± 0.037 ^{a}

* Values with the same letters indicate insignificant difference ($P<0.05$) and vice versa.
Values are expressed as means ±SE

Other components of pumpkin have also been separated and their ability to prevent diabetes has been examined. For instance, according to Kwon et al. [29], pumpkin's phenolic phytochemicals inhibit alpha-amylase and beta-glucosidase, which are markers of diabetes. Additionally, Quanhong et al. [34] studied hypoglycemic compounds from pumpkin and separated protein-bound polysaccharide from water-soluble components of the fruits using activity-guided isolation. In rats with alloxan-induced diabetes, this protein-bound polysaccharide from pumpkin fruits (PBPP) was assessed for its hypoglycemic activity and effects on serum insulin levels. It was discovered that PBPP can raise serum insulin levels, lower blood glucose levels, and improve glucose tolerance in diabetic animals.

By considering all these facts, it can be concluded that pumpkin has potential anti-diabetic properties, which may suggest the inclusion of this plant in anti-diabetic regimens to treat human diabetes. However, authors insist that more animal and clinical trials are needed to firmly establish molecular mechanisms of actions, evaluate activities and associated health benefits of pumpkin seeds in the prevention of diabetes in humans. [6] .

3.4 ANTI MICROBIAL EFFECTS :

For millions of people, diseases brought on by bacteria, viruses, fungus, and other parasites are the main causes of death, disability, and social and economic disruption [6]. Despite the availability of safe and efficient therapies, many people do not have access to the necessary treatment and prevention services. Antimicrobial resistance is predicted by statistics to increase the death rate to 10 million deaths yearly by 2050, which is frightening because the current projection is only 700,000 fatalities annually [35, 5]. The need for novel medications to combat pathogenic microorganisms has arisen from the rise in drug resistance in infectious microorganisms. Natural sources have been thought to be the greatest choice in this regard for isolating fresh and unique anti-microbial components. Studies using cell cultures have shown that pumpkin seed extract has promising antibacterial action against a variety of microorganism types. Effective antibacterial activity of the seed extract is demonstrated against Escherichia coli, Klebsiella pneumonia, Pseudomonas putida, Pseudomonas aeruginosa, Bacillus subtilis, Staphylococcus werneri, and Pseudomonas aureus. Moreover, a pumpkin seed protein isolate called cucurmoschin inhibits the growth of fungi called Botrytis cinerea and Fusarium oxysporum at the mycelial stage [5,36,37]. Aeromonas veronii, Candida albicans, Enterociccus feacalis, Escherichia coli, Salmonella enterica, Typhimurium, and Staphylococcus aureus Hammer et al. [38] are also inhibited by pumpkin seed oil at a concentration of 2 percent. It has been demonstrated that a peptide

(MW 8 kDa) derived from pumpkin seeds inhibits Mycosphaerella arachidicola, Fusarium oxysporum, and Botrytis cinerea at a dose of 375 mg. Additionally, the peptide has an inhibitory effect on cell-free translation, with an IC50 (50 percent inhibitory concentration) of 1·2 Mm [39]. Two proteins with a MW of 12 kDa that were purified from fresh brown pumpkin seeds, a-moschin and b-moschin, showed translation-inhibiting activity with IC50 values of 17 mM and 300 nM, respectively [40]. It has been demonstrated that three pumpkin seed basic proteins—MAP2 (MW 2·2 kDa), MAP4 (MW 4·6 kDa), and MAP11 (MW 11·7 kDa)—inhibit yeast cell growth. MAP11 is the most potent inhibitor. But the growth of the Gram-negative bacterium E. coli was not inhibited by MAP2 or MAP4 [41]. Furthermore, it has been documented that phloem from pumpkin fruit exudates inhibit pathogenic fungal proteases, hence having anti-fungal properties. A novel protein named Pr-1 was recently identified from pumpkins by Park et al. [43]; it has the potential to have anti-fungal activity and is safe for human erythrocytes. This protein is thermostable and stable up to 70 degrees Celsius. It does not exhibit growth-arresting effect against Staphylococcus aureus or E. coli [42, 43].

3.5 ANTI DEPRESSANT EFFECT:

Depression is a prevalent disorder characterized by phases of inhibited psychosocial functioning and a loss in quality of life, including symptoms such as disturbed sleep and appetite, decreased concentration, excessive guilt, and suicide ideation [44, 45]. Because depression has unpredictable appearances, a variable prognosis, and a variable response to treatment, psychotherapists typically face significant practical obstacles in the identification, diagnosis, and management of depression. According to reports, over 4 million people experienced depression-related issues in 2001. In 2008, depression was listed as the third leading cause of disease burden worldwide, but by 2030, it is expected to rise to the top [45–49]. Depression would kill countless lives if effective and quick action wasn't taken. There have been reports of antidepressant chemicals found in certain plants [50–55]. LaChance and Ramsey [55] have provided a characterization of the antidepressant foods and reported that pumpkin seeds had an antidepressant food score (AFS) of 47%. This means that the pumpkin seeds possess antidepressant potential [56]. In a different investigation, rats were used to compare the effectiveness of pumpkin seed extracts (PSE) with the conventional medication imipramine through forced-swimming and tail-suspension tests. According to the study's findings, pumpkin seeds have a considerable antidepressant effect. Hibbeln [57] and Eby [58] connected the antidepressant effect to tryptophan, an essential amino acid, and 5-hydroxytryptophan, an intermediate tryptophan metabolite in the formation of the neurotransmitter serotonin, both of which are promoted as treatments for depression [59,60], even though the exact mechanism of action of PSE is still unclear. Moreover, studies concentrating on animal and clinical trials are required to disclose and validate pumpkin seed's mitigating impact on depression. Information regarding the potential of pumpkin seeds is scarce in this field.

3.6 OTHER NEUTRACEUTICAL PROPERTIES:

Foods enriched in pumpkin are thought to be a good source of anti-inflammatory compounds, which can aid in the treatment of a variety of illnesses like arthritis, etc. According to Fahim et al. [61], pumpkin seed oil greatly reduced adjuvant-induced arthritis in rats, much like the well-known anti-inflammatory drug indomethacin.

When Fahim et al. (61) examined the effects of pumpkin seed oil and indomethacin as a medication combination, they observed no change in the adjuvant-induced arthritis model in rats. There are hypotensive properties in pumpkin seeds. Regarding improved hypotensive potential in hypertensive animal models, Zuhair et al. [62] have proposed that pumpkin seed oil has a very good pharmacological interaction with hypotensive medications like felodipine (a Ca antagonist) and captopril (an angiotensin-converting enzyme inhibitor). In Thailand, the incidence of bladder stone disease will be decreased as a result of the addition of pumpkin seed snacks, which demonstrated a greater level of inhibitor of crystal formation or aggregation [62,63]. Twenty boys and girls, ages two to seven, from a hyper-endemic area of Thailand's Ubol province are the subjects of an investigation into the impact of supplementing with pumpkin seeds on urine composition axalcrystallurea. The four time periods of the experimental research study were manage (prior to cure), supplementation of oxalate 5 mg/kg body weight daily, supplementation of pumpkin seed 60 mg/kg body weight daily, and 24-hour urine collection and analysis after treatment for crystalluria, calcium, phosphorus, creatinine, pH, oxalate, citrate glycosaminoglycans, sodium, potassium, and pyrophosphate. The effects tested that the pumpkin seeds supplementation period longer, the outcomes will be the better [64,65] .

Apart from the above-discussed thematic nutraceutical functions, the results of clinical trials on recurrent acute periodontitis (RAS) and animal models of obesity induced by high-fat diets [66, 67], as well as effects on hepato-inflammation and lipotoxicity [68, 69], indicate that pumpkin seed oil (PSO) and pumpkin seed extract (PSE) have the potential to improve wound healing.

Shishigatani pumpkin's ethyl acetate and chloroform fractions showed bio-antimutagenicity [71, 72].

Because pumpkin seeds contain L-tryptophan, which increases the brain's levels of "happy" serotonin, pumpkin may also help with depression. Water extracts of pumpkin seeds have shown promise in treating experimentally infected puppies with heterophyiasis; in fact, the combination extracts of pumpkin seeds and areca nut performed better than either extract administered alone.

In preclinical experiments, an anti-helminthic effect was observed at the least inhibitory dose of 23 g pumpkin seed in 100 ml distilled water. When pumpkin seed proteins were given to intoxicated individuals, the activity levels of lactate dehydrogenase, alanine transaminase, aspartate transaminase, and alkaline phosphatase were dramatically lowered. As a result, protein malnutrition's negative effects were effectively mitigated [72–75].

Additionally, PSO considerably outperformed the placebo group in Ramak and Mahboubi's study [76], showing a considerable anti-androgenic impact (increasing hair growth) in addition to a much better self-rated improvement score. It is said that the phytosterol and phenolic content of pumpkin seed oil is the reason behind its inhibitory effect on androgen in rats.

IV. USE OF PUMPKIN SEED FLOUR IN BAKERY PRODUCTS :

Five types of bakery products (sandwich bread, sweet bread, butter cake, chiffon cake, and cookies) were chosen by a group of 350 consumers in Lampang Province, Thailand. The standard formulations of the products were as follows:

1. Sandwich bread: 100% wheat flour; and 0.5% bread improver, 4.45% skim milk powder, 1% dried yeast, 62.5% water, 4% sugar, 1.65% salt, and 6% shortening pumpkin powder was substituted as % of wheat flour as % of wheat flour.

2. Sweet bread: 75% wheat flour, 25% allpurpose flour; and 0.7% bread improver, 44% fresh milk, 1.6% dry yeast, 16% egg, 14.8% sugar, 1.25% salt, and 16% butter pumpkin powder was substituted as % of wheat flour as % of wheat flour.

3. Butter cake: 100% cake flour; and 5% corn flour, 0.8% baking powder, 0.8% vanilla, 112.5% sugar, 0.4% salt, and 113.5% butter pumpkin powder was substituted as % of wheat flour as % of cake flour.

4. Chiffon cake: 100% cake flour; and 8% milk powder, 4% baking powder, 0.2% vanilla , 80% sugar (1), 1% salt, 100% egg yolk, 170% egg white, 75% water, 50% rice oil, 0.5% cream of tartar and 90% sugar (2) pumpkin powder was substituted as % of wheat flour as % of cake flour.

5. Cookies: 100% all-purpose flour; and 8.9% skim milk powder, 1.4% baking powder, 0.6% salt, 61.5% margarine, 18.5% egg, 61.5% sugar and 16.6% water pumpkin powder was substituted as % of wheat flour as % of all-purpose flour.

V. CONCLUSION

The results of this investigation showed that adding pumpkin seed powder to enriched bread products greatly increases their amount of β-carotene. It was shown that adding pumpkin seed flour, either raw or roasted, to cookies—a popular bakery item around the world—is far more acceptable than adding it to the control samples. Pumpkin seed flour can be added, however no more than 30% should be allowed. The cookies that were supplemented with raw or roasted pumpkin seed flour had higher levels of protein, fat, ash, iron, zinc, total carotenoid content, and antioxidant activity than the control samples. The enhanced cookies had a lower peroxide value. To improve people's nutritional status, it may be inferred that goods containing pumpkin seed flour should be encouraged to be consumed as part of a regular diet. To end malnutrition, value-added products made with raw or roasted pumpkin seed flour can be given to women and children as supplements. Cookies may also be included in programmes for supplemental nutrition.

The nutritious profile of cookies was significantly ($P \leq 0.05$) improved by adding germinated pumpkin seed flour. These kinds of products can be quite helpful in addressing the issue of micronutrient deficiencies in people of all ages. The produced product's shelf life is being studied, and the results will be shared in a future

announcement. The aforementioned studies also demonstrated that pumpkin seeds are a pleasant snack in many parts of the world in addition to having nutritional and medicinal characteristics. Plantations in tropical and subtropical regions are home to pumpkin seeds. Three primary varieties, Cucurbita pepo, Cucurbita maxima, and Cucurbita moschata, are grown. According to nutrient composition research, pumpkin seeds are highly nutrient-dense and a great source of several important nutrients. On the other hand, pumpkin seeds have been utilised medicinally and are also important in terms of nutrition and treatment. In addition to being used to treat and control conditions like diabetes, inflammation, hyperlipidemia, hypertension, cancer treatment, and heart protection, pumpkin seeds are an important source of micronutrients.

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