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Phytochemical potential and associated health benefits of *Cucurbita* flower

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Abstract: Edible flowers are currently gaining popularity as the majority of the edible flower species have a nutritional profile that meets several dietary demands and the consumption of flowers as part of customary cuisine or alternative alchemy is reported in various cultures around the world. Pumpkin flowers are primarily consumed in some Asian and North American countries like India, China, Bangladesh, and Mexico, respectively. The pumpkin plant has served medicinally worldwide by treating wounds, cardiovascular disease, several types of cancers, gastrointestinal diseases, anemia, urinary tract infections and intestinal parasites, however, its flowers among the same line have also been therapeutically used to treat wounds and male infertility. These therapeutical effects are solely associated with their nutritional and phytochemical configuration. In this aspect, the present review focuses on providing a detailed overview of its morphological, physicochemical, thermal, and therapeutic properties within which, special emphasis is provided towards the mechanism followed by each bioactive component in treating the corresponding disease. The evaluation of therapeutic properties will help in understanding the pumpkin flower's processing requirements. Its functional and nutritional potential can further help develop value-added products and supplements.

Key words: Pumpkin flower, nutritional composition, phytochemicals, physicochemical attributes, health, therapeutic applications

1. Introduction

Plants particularly horticulture section are raw materials and used by people for food, either as edible products, or for culinary ingredients, medicinal use or ornamental and aesthetic purposes. They are genetically very diverse groups and play a major role in modern society and economy. Horticulture plants including edible flowers are an important component of traditional food but are also central to healthy diets of modern urban population (Nadeem et al., 2018; Mlcek et al., 2021; Abanoz and Okcu, 2022; Juric et al., 2021; Cseke et al., 2022; Taskesenlioglu et al., 2022).

Pumpkin belongs to the family Cucurbitaceae and genus *Cucurbita*, it consists of 118 genera and 825 species from which some of the major species are *C. maxima*, *C. argyrosperm*, *C. ficifolia*, *C. moschata*, and *C. pepo* (Ahmad and Khan, 2019). It is a creeping plant and is mainly famous for its fruit and seed, but the peels, leaves, and flowers are also consumed in diverse parts of the world in several different forms (Yadav et al., 2010). The pumpkin vine produces unisexual, actinomorphic, and acuminate with pentamerous perianth flowers, their color varies from bright yellow to orange (Kiramana and Isutsa, 2017). The difference between male and female flowers is significant, with the presence of a 3–5 cm long ovoid ovary on the receptacle part of the female flower while male flowers are generally long and pedicellate with the common ratio of (male: female) ranging from (4:1) to (14:1) (Chatt et al., 2018).

Culturally pumpkin flowers are popular in China, Mexico, India, and different parts of the USA for their esculent nature. Traditionally, flowers are used as a remedy for male infertility, minor injuries, and mild fever as they are rich in calcium, potassium, and sodium (Ghosh and Rana, 2021). The presence of carotenoids and gallic acid provides pumpkin flowers with antiinflammatory and anticancer properties, respectively. Moreover, due to their high antioxidant activity, the pumpkin flowers can also improve, the immune function and biological activity of the human body by reducing oxidation (Ghosh and Rana, 2021).

Though edible flowers have already been used in ancient Rome, Greece, India, and China for medicinal, culinary, and decorative purposes but their role as flavoring,

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coloring, and aesthetical agents in the food industry are extensively discussed due to their well-known properties, like appearance and aroma (Rezende et al., 2019). Interest in edible flowers is ascending currently, due to their bioactive components and nutritional composition. Several species such as (chrysanthemum, hibiscus, lavender, pansy, peony, marigold, rose, etc.) have been evaluated thoroughly in the same aspects (Fernandes et al., 2017).

In addition to their chemical composition and biological properties, they are an easily available, renewable, and affordable source of bioactive compounds which makes edible flowers an attractive and capable source of functional food (Gostin and Waisundara, 2019). Value-added products like tastemaker, instant juice, and salad dressing can be prepared by using the flowers in dried form while in fresh form their juice, beer, curry, and fritters can be prepared (Alam et al., 2019; Soumya et al., 2021). This review paper provides extensive information related to the nutritional composition and physicochemical properties of the pumpkin flower that can further help in upcoming research related to its processing, storage, functional food, or value-added product development.

2. Variety and morphology of pumpkin flowers

The pumpkin flowers are monoecious i.e. the male (staminate) and female (pistillate) flowers are present on the same plant, but are produced separately and have corollas divided into five narrowing to a sharp-pointed lobe (Chomicki et al., 2020). The flower is radially symmetrical- it can be divided, by more than one line passing through the middle of the flower, into two equal parts and those parts are mirror images of one another, and hence it can be called an actinomorphic inverted bell-shaped flower (Hileman, 2014). The color ranges from yellow to orange with a hue value of 74°, which denotes a quantitative representation of color and the high chroma value of 55.56 indicates the saturation of the color (Neelamma et al., 2016).

After the pumpkin seeds are planted the male flowers emerge within 30 to 50 days of the plantation, while the female flowers emerge after 60 to 80 days (Petersen et al., 2013). Pollination takes place and the fruit starts developing under the female flower. The fruits get mature within almost 30 days of their emergence (Rachel and Oscar, 2021) as presented in Figure 1.

The female flower (Figure 2A) and male flowers (Figure 2B) have long, thin peduncles (stalks of flower), united filaments, and anthers that produce pollen grains (Figure 2C). The style of the female flower consists of three chambers which constitute three lobes (Figure 2D) and in some flowers, staminodes are also present. The female flowers have an ovary structure which appears as undeveloped fruit, on a short and thick peduncle that later becomes the fruit stalk (Figure 2E, 2F) (Manjunathagowda and Bommesh, 2017).

The female flowers (6–12 cm) are more extended than the male flowers (3–5 cm) (Yadav et al., 2010). Most, varieties of pumpkin plants produce male flowers first and female flowers later, which helps in cross-pollination but it necessarily does not ensure cross-pollination. The common ratio of male and female flowers on a vine is (14:1) and the number of developing fruits already present on the vine also affects this ratio (Kiramana and Isutsa, 2017).

3. Physical properties of pumpkin flowers

Physical properties are the properties that make any product self-descriptive and quantify it by physical rather than chemical means (Berk, 2018) and these properties are of great significance in the food industry as the understanding of many of these properties, such as bulk density, volume, mass, surface area are essential for the designing and optimizing the processors like graders, sorters, cutters, and processing conditions like drying, freezing time/temp (Dennis, 2011).

The mass, length, width, and thickness of the flowers are (4.88 g, 90.43 mm, 51.56 mm, and 22.63 mm), respectively (Ghosh and Rana, 2021; Elizabeth et al., 2018). The surface area plays an important role in heat mass transfer and respiration rate calculations and for pumpkin flowers, its value is 23.5 cm^2 (Ambarita and Nasution, 2018; Robert et al., 2019; Ghosh and Rana, 2021). The weight per unit volume (Bulk density) and volume of the pumpkin flower is 0.11 g/mL and 51.96 cm^3 (Ghosh and Rana, 2021). The lower value of bulk density and higher value of volumes show the flowers have a high moisture content ranging from 85.03% to 95.15%. More than half part of the flowers are consumable and this is due to the light weight of petals than the stem and sepals (USDA, 2010; Kalyankar et al., 2016).

4. Nutritional properties of pumpkin flowers

Nutrients in food are those molecules that an organism requires for energy to grow, develop, and reproduce. There are two main types of nutrients, macronutrients (carbohydrate, protein, and fat) and micronutrients (vitamins and minerals) (Ercisli et al., 2005; Erturk et al., 2012; Sarah et al., 2013; Ikinci et al., 2014; Jaćimović et al., 2020; Yildiz et al., 2022). The carbohydrate, total sugar, total solids, crude fiber, crude fat, ash, pH, and protein content of pumpkin flower is shown in Table 1 (Edward et al., 2013; Kathina et al., 2015; Ghosh and Rana, 2021). Comparatively, the fat 0.11% and protein 1.63% content of the pumpkin flowers are lower while the value for fiber 4.33%, ash 1.78%, and carbohydrate 5.28% content is higher than other edible flowers like *Curcuma plicata,*

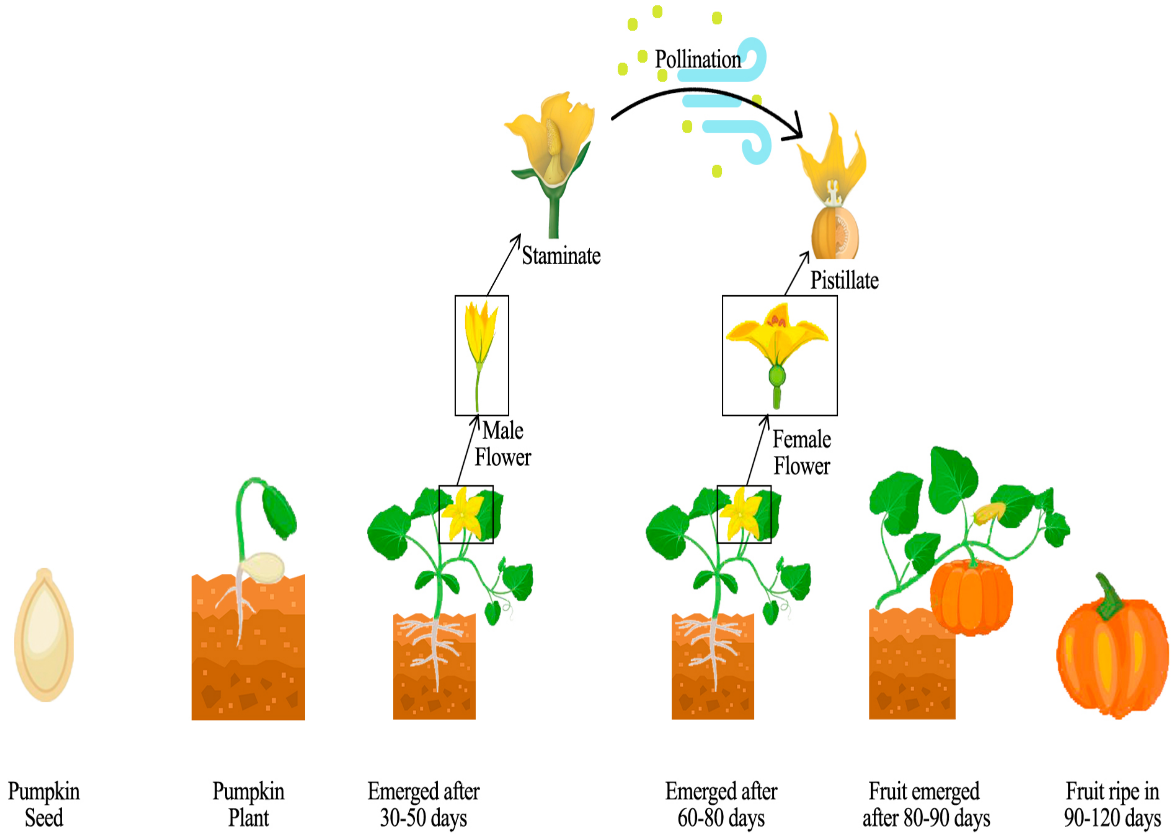

Figure 1. Schematic representation of different growth stages of the pumpkin plant.

Alpinia galanga, Amomum maximum, Zingiber ottensii, Z. zerumbet, Z. officinale, Hedychium forrestii (yellow filament), *H. forrestii* (orange filament), *Etlingera elatior, Tropaeolum majus, Tagetes erecta, Spilanthes oleracea,* Rose, Sunflower and Calendula for which the values for crude fibre, ash, and carbohydrate ranged in between 0.58%–3.58%, 0.65%–1.66%, and 2.15%–5.18%, respectively (Gonzalez et al., 2014; Rachkeeree et al., 2018).

The fatty acid composition of pumpkin flowers is 73.46% saturated, 22.26% monounsaturated, and 8.85% polyunsaturated fatty acids. Oleic acid (21.55%) is the most prominent among all the fatty acids present in pumpkin flowers (Table 1) (USDA, 2010). In comparison to other edible flowers like *Allium. schoenoprasum, Anchusa. Aurea, Azadirachta. indica, Calendula. officinalis, Capparis. spinosa L, Cassia. fistula L, Centaurea. cyanus, Chrysanthemum. morifolium, Cichorium. intybus, Taraxacum. sect, Ruderalia, Dahlia. mignon, Gundelia. tournefortii* the amount of palmitic, oleic, and linoleic acid is slightly low, while the amount of other fatty acids such as capric, lauric, myristic, palmitoleic, stearic, arachidic, and behenic acid is significantly high in pumpkin flowers (Fernandes et al., 2018). The mineral composition of the pumpkin flower has shown a conspicuous amount of potassium (173 mg/100 g) like other edible flowers (Edward et al., 2013; Fernandes et al., 2018; Ghosh and Rana, 2021), but the level of phosphorus, calcium, and sodium were exceptionally high (Table 1 and 2) (USDA, 2010; Edward et al., 2013; Ghosh and Rana, 2021). The pumpkin flowers provide 15 kcal/100 g of energy which is similar to the energy provided by *Z. zerumbet* flower of the ginger family (USDA, 2010; Rachkeeree et al., 2018). The concentration of vitamin A 584.1 mg/100 g and vitamin C 28 mg/100 g is prominent for pumpkin flowers likewise concentration of vitamin C has been reported for *Brassica. oleracea* 25 mg/100 g (USDA, 2010; Lara et al., 2014; Ghosh and Rana, 2021).

5. Phytochemical composition of pumpkin flowers

Phytochemical means plant (Phyto) chemical refers to an extensive variety of compounds that are naturally present in plants and these compounds are bioactive that is they have the potential to influence certain metabolic functions depending on the amount/concentration in which they are available (Thakur et al., 2020; Ebrahimzadeh et al., 2021; Kibar et al., 2021; Kupe et al., 2021; Bozhuyuk et al., 2022).

Generally, phytochemicals depending on their chemical structure, are classified into five major

Figure 2. It shows (A) Female flower, (B) Male flower, (C) Anther and filament of male flower, (D) Stigma and style of female flower, (E) Peduncle of male flower, (F) Peduncle of female flower.

categories- carbohydrates, lipids, phenolics, terpenoids, and alkaloids (Huang et al., 2016). As shown in Table 2, the major phytochemicals in pumpkin flowers are carotenoid (373 mg/100 g) which is almost similar to other yellow-orange flowers (marigold, sunflower, rose, and pansy) followed by gallic acid (17.39 µg/mL), quercetin (17.134 µg/mL), anthocyanin (11.2 mg cyn-3-Glu eq/100 g), and beta-carotene 800 mg/100 g (Kathina et al., 2015; Nayak et al., 2017; Ghosh and Rana, 2021). In comparison to the pumpkin flowers, the pumpkin fruit constitutes a higher amount of gallic acid 436 mg/100 g, quercetin 8.23 mg/100 g, and alkaloid content 180 mg/100 g, while the anthocyanin, beta carotene and carotenoid content of pumpkin flower are high (Oloyede, 2012; Carvalho et al., 2017; Khatib and Muhieddine, 2019; Kaur et al., 2020). The flowers can be stored at 10 °C for 5 days and it has been observed in a study that beta carotene content increased by 50% from 6 mg/100 g to 9 mg/100 g during storage (Kathina et al., 2015).

6. Thermal and textural properties of pumpkin flowers

The thermal properties in terms of food are the properties that affect the heat transfer through or in/out of food and they are important for designing processing equipment and estimating storage, and processing conditions as well (Obot et al., 2017). The specific heat capacity is the amount of heat absorbed per unit mass of any material when its temperature increases by 1 °C (Feidt, 2017) and its value for pumpkin flower is 4.071 (kJ/kg °C) which shows it will take a small amount of heat to raise its temperature (Ghosh and Rana, 2021).

Thermal conductivity is the measure of the ability of any material to conduct heat and its value for pumpkin flower is 0.620 (J/ms °C) which shows heat can be easily conducted through these flowers, while the thermal diffusivity reading for the same is 0.127 ($\mu m^2/s$) (Ratna, 2012). The textural properties are those physical characteristics that arise from the structural element of that particular material and thus are a direct signifier of food quality and processing (Lu, 2013). The values of deformation, adhesiveness, stringiness, cohesiveness, springiness index, gumminess, and chewiness for pumpkin flower are 49.90%, 0.20 mJ, 0.10 mJ, 0.58, 0.49, 26.00 g, and 4.70 mJ, respectively. Lower values of all the textural parameters represent that the flower sample is moist and fresh (Ghosh and Rana, 2021).

Table 1. Nutritional composition of a fresh pumpkin flower.

Nutritional parameters	**Values**	**References**
Moisture (%)	85.03	(USDA, 2010; Edward et al., 2013; Khatina et al., 2015; Ghosh and Rana, 2021)
Ash (%)	1.78	
Crude fat (%)	0.11	
Protein (%)	1.63	
Crude fiber (%)	4.33	
Energy (kcal)	15	
Vitamins (mg/100 g)		(USDA, 2010; Ghosh and Rana, 2021)
Vit C	28	
Vit B1	0.075	
Vit B2	0.042	
Vit B3	0.690	
Vit B9	0.059	
Vit A	584.1	
Minerals (mg/100 g)		(Edward et al., 2013; Fernendas et al., 2018; Ghosh and Rana, 2021)
Na	11.5	
P	33.6	
Ca	28.3	
Mg	13.37	
S	1.23	
Fe	2.43	
K	173	
Cu	0.75	
Se	0.0007	
Fatty acid composition (%)		(USDA, 2010; Fernendas et al., 2018)
Capric acid	9.78	
Lauric acid	11.26	
Myristic acid	13.78	
Palmitic acid	17.06	
Stearic acid	21.06	
Arachidic acid	23.04	
Behenic acid	26.66	
Palmitoleic acid	17.46	
Oleic acid	21.55	
Linoleic acid	21.90	

7. Therapeutic applications of pumpkin flowers

The pumpkin flowers are therapeutically used as a remedy for wound injury, fever because of their antimicrobial and antiinflammatory properties, male infertility, cataract, and osteosarcoma due to the higher concentration of calcium, vitamin C, crude fiber, potassium, and beta carotene, respectively (Valsa et al., 2015; Nayak et al., 2017; Kawata et al., 2018; Soliman, 2019; Lim et al., 2020; Ghosh and Rana, 2021).

7.1. Antimicrobial effect

The pumpkin flower extract shows antimicrobial activity against *Salmonella. typhi, E. coli, Enterobacter. faecalis, Bacillus. cereus, Curvularia. lunata, Candida. albicans* (Muruganantham et al., 2016). While the minimum

Table 2. Phytochemical properties of pumpkin flower and pumpkin fruit.

Phytochemicals	Flowers	Fruit (mg/100g)	References
Gallic acid	17.39 μg/mL	436.16	(Oloyede, 2012; Ghosh and Rana, 2021)
Quercetin	17.13 μg/mL	8.23	(Khatiban and Muhieddine, 2019; Ghosh and Rana, 2021)
Atropine	2.29 μg/ mL	180	(Carvalho et al., 2017; Ghosh and Rana, 2021)
Anthocyanin (mg cyn-3-glu eq/100 g)	11.2	7.4	(USDA, 2010; Khatiban and Muhieddine, 2019)
Beta Carotene	800 mg/100 g	29.7	(Khatina et al., 2015; Chun et al., 2017)
Carotenoid	373 mg/100 g	44.2	(USDA, 2010; Chun et al., 2017)

concentration of 25, 25, 25, and 50 μg/mL of flower extracts is required for the inhibition of *B. subtilis*, *E. coli*, *P. aeruginosa*, and *V. cholerae* strains, respectively (Nayak et al., 2017). The quercetin from flower extracts might be responsible for the observed antimicrobial activity as these constituents generally act as the defence against microbial infections (Abifarin, 2019). Studies have shown that quercetin effectively inhibits the growth of *E. coli, S. aureus, and P. aeruginosa.* The minimum inhibitory concentration value ranges from 2.07 to 8.28 mg/mL (Yao et al., 2011). According to research studies, quercetin mainly follows the mechanism of destroying the cell wall of bacteria and changing its permeability by affecting protein synthesis and expression which ultimately hampers its metabolism (Wang et al., 2018) and the same has been presented in Figure 3. The antibacterial property of pumpkin flowers could be the reason for their remedial usage in normal fever (Rigat et al., 2015).

7.2. Antiinflammatory effects

The pumpkin flowers are rich in beta carotenoids and quercetin which are known to inhibit the lipopolysaccharide-induced Cox2 and iNOS expression which results in the antiinflammatory effect and this might result in the antiinflammatory characteristics of these flowers too (Kawata et al., 2018) (Figure 3).

7.3. Anticarcinogenic effect

As the flowers are rich in antioxidants (carotenoids, gallic acid, and quercetin) which scavenge various reactive oxygen species like singlet oxygen, superoxide, hydroxyl radical, peroxyl radicals, and nitric oxide (Tanaka et al., 2012). Though pumpkin flowers can prevent several cancers majorly they are found very effective against osteosarcoma, which is a well-known nonhaematological malignancy associated with bones (Nayak et al., 2017; Misaghi et al., 2018). Gallic acid induces apoptosis of osteosarcoma cells, by upregulating p-38 activation and downregulating c-Jun N-terminal kinase (JNK) and extracellular signal-regulated kinase (ERK1/2) activation (Liang et al., 2012) (Figure 3). The extracts of *C. maxima* show a half-maximal inhibitory concentration of 54.62, which is very effective against MG-63 osteosarcoma cell lines (Nayak et al., 2017). The antioxidant activity of the pumpkin flower is 51.65% (Ghosh and Rana, 2021).

7.4. Wound healing

Though the antimicrobial activity of pumpkin flowers may also contribute to wound healing (Ghildiyal et al., 2015), the high amount of potassium and sodium mineral in flowers might also contribute. As the concentration of potassium and sodium ions in the cell stimulates the potassium and sodium channels (Johns, 2014). By consequent depolarization (movement of Na+ ions) in the cell due to their higher concentration outside the cell and repolarization (the outward movement of potassium ions from the cell), the potential equilibrium of the plasma membrane is maintained (Beigi et al., 2019; Zhang et al., 2020) (Figure 3). Depolarization demonstrates regeneration and wound healing (Reid and Zhao, 2014).

7.5. Male infertility

It can be due to the combination of low sperm count, poor sperm motility, or unusual sperm morphology (Kumar and Singh, 2015), and all these functions in one way or another are modulated by intracellular calcium and potassium ion concentration (Valsa et al., 2015; Beigi et al., 2019) (Figure 3). Progesterone (P) and zona pellucida are known to induce acrosome reactions in human sperm by increasing cytosolic calcium. A good amount of (K^+) ions improves the rate of the acrosome reaction in human sperm which allows the sperm by the release of acrosomal enzymes to penetrate the zona pellucida of the egg during fertilization (Jin and Yang, 2017). Incubation of capacitated sperm with different concentrations of potassium chloride (1.25–20 mM) resulted in a dose-dependent increase in Ca^{2+} ions (Kumar et al., 2000). Calcium ions have a direct effect on sperm motility. In the epididymis layer, the calcium ions simulate immature sperm, whereas in ejaculated medium the calcium ions inhibit sperm motility (Polina et al., 2014). As represented in Table 2, pumpkin flowers are rich in both of these minerals which might result in the prevention of male infertility by maintaining or boosting the concentration of these minerals in seminal plasma.

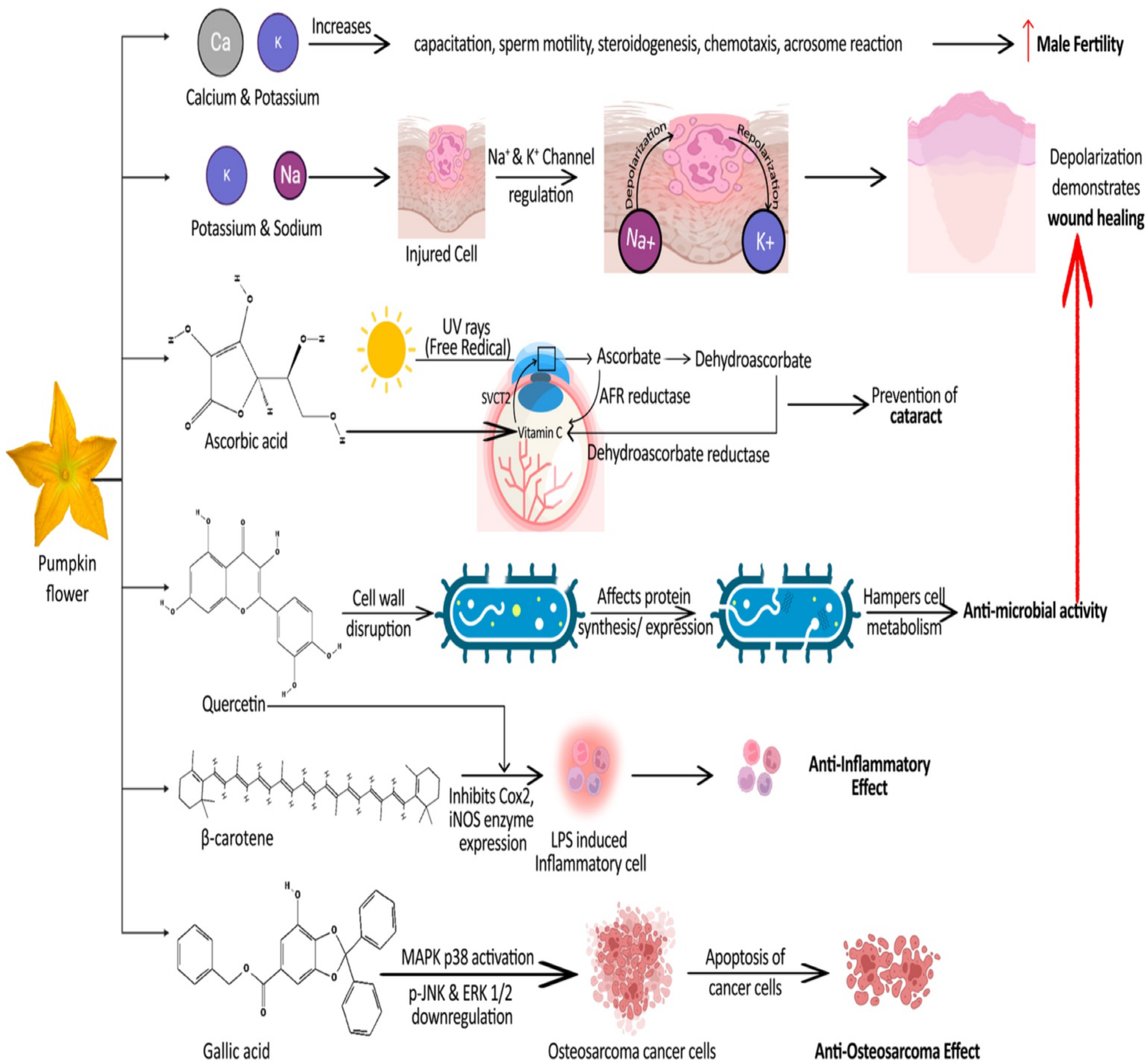

Figure 3. Therapeutic applications of pumpkin flower- male infertility, wound healing, cataract, antimicrobial, antiinflammatory, antiosteosarcoma [Liang et al 2012; Wang et al., 2018; Kawata et al., 2018; Beigi et al., 2019; Salehi et al., 2019; Zhang et al., 2020].

7.6. Cataract

It is a crystalline lens abnormality characterized by decreased transparency and increased haziness (Lam et al., 2015). The most prominent cause of cataracts is attributed to the exposure of the eye lens to molecular oxygen, which results in oxidative damage to lens nucleus protein, aggregation of which results in scattering of light and ultimately transparency loss of lens (Moreau and King, 2012).

It can be prevented by the surplus diet of ascorbic acid, which is an antioxidant. Although it is normally present in the fluid of the eye the vitamin C from pumpkin flowers can boost that same amount (Salehi et al., 2019; Lim et al., 2020). The antioxidant property of vitamin C is due to its ability to oxidize itself by donating electrons to free radicals from both the second and third carbon sites (Pehlivan, 2017). In this process of quenching reactive oxygen species, vitamin C is oxidized to dehydroascorbate, that can be reduced back to vitamin C, either via glutathione-dependent enzymes or no enzymatically by using low molecular weight antioxidants like glutathione or cysteine (Lim et al., 2020) (Figure 3). Diurnal guinea pigs which also as humans rely on a dietary source for vitamin C were placed under an experimental study in which one set of guinea pigs was put on a dietary concentration of 50 mg/day of vitamin C and the other set of guinea pigs were fed with 2 mg/day of vitamin C diet, in both sets of pig's cataracts were induced by exposing them to 0.25–0.75 J/cm^2 UV-B radiation for 10 min. A lower amount of vitamin C was observed in the eye fluid of pigs which were fed with a lower concentration of diet and 50% more eye protein damage was also observed for the same set of pigs (Lim et al., 2020).

8. Future prospects

As pumpkin flowers are a rich source of potassium and crude fibre, their effect on blood pressure regulation and atherosclerosis prevention can be studied in the respective aspects. Blood pressure is the force of circulatory blood on the artery walls (Kumar et al., 2016). The potassium concentration of pumpkin flowers might regulate blood pressure (Mahabir, 2020). As the depolarized skeletal muscle cells release the potassium ions in the interstitial space surrounding arterioles that stimulates the Na-K pump (it transports Na^+ ions out of the cell and K^+ ions into the cell, in a ratio of 3:2, respectively) (Pirahanchi et al., 2021) in vascular smooth muscle cells and because of the unequal transportation of sodium and potassium ions results in hyperpolarization of the cells, reduced calcium influx of smooth muscle cells, resultant of which the membrane potential changes, which reduces the pressure in arterioles and blood flow is increased (Brozovich et al., 2016). Moreover, pumpkin flower being a plant source of fatty acid is typically rich in monounsaturated fats (Table 2), ones that help in reducing systolic and diastolic blood pressure (Lukas and George, 2012).

While Atherosclerosis is the accumulation of fats, cholesterol, and other such substances (plaque) in/on the artery walls of the heart, (Rafieian-Kopaei et al., 2014) which causes the arteries to narrow, hindering blood flow and might result in plaque burst, leading to the blood clot, stroke, and heart attack (Tavafi, 2013). The crude fibre helps in lowering the low-density lipoprotein cholesterol by attaching to these molecular constituents in the small intestine, preventing them from entering the bloodstream and ultimately their flow to the arteries (Soliman, 2019). Rich fibre also encourages easy bowel movement. The surplus amount of atropine and carotenoid in pumpkin flowers makes it a pertinent source for preventing bradycardia which is a condition of low heart beat (60 to 100 beats/min) (Peschanski et al., 2017) and age-related cataracts.

The amino acid profiling of pumpkin flowers can be done for enhancing their bioactive profile and medicinal usage. Eventually, not the least foremost application of pumpkin flowers as a functional food in public health affinity is associated with great availability and health benefits. But its safety profile is yet to be evaluated, knowledge of which will guide us for safe public utilization and industrial application of pumpkin flowers.

9. Conclusion

The use of Cucurbita flowers in various studies revealed that they are composed of multiple effective and useful compounds, which provides an opportunity for further research and production of formulations having antiinflammatory, antimicrobial, and antioxidant properties. Indeed, the use of pumpkin flowers as a remedy for wound healing and male infertility dates from a long time ago. The present review markedly highlights that pumpkin flowers have preventive and remedial abilities for the treatment of different diseases. The presence of bioactive compounds in pumpkin flowers further consolidates the opportunity for their application as an upcoming antimicrobial, anticancerous, anticataract, and cardioprotective agents, especially for blood pressure regulation and atherosclerosis.

The study has revealed that pumpkin flower constitutes multiple effective and useful bioactive compounds among them potassium, calcium, gallic acid, carotenoids, vitamin C, and atropine are the most significant ones which can be further studied for curing health issues like blood pressure, atherosclerosis, and bradycardia. The pumpkin flowers were traditionally used as a therapeutical agent against fever, male infertility, and minor injuries but, recently antiinflammatory, antimicrobial, anticataract, and anticancer (osteosarcoma) properties were also explored. The presence of these constituents and corresponding properties makes it an affluent source of functional food.

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Author's contributions

JS in conceptualization and supervision, AG in writing original draft, PR in reviewing, editing and supervision, SK in reviewing and editing, JK in writing-review and editing, CS in reviewing and editing, YS in editing, and RC in editing.

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The authors declare no competing interests.

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