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A short review of *Polianthes tuberosa* L. considered a medicinal plant in Bangladesh

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Abstract
Polianthes tuberosa L. is a flowering plant belonging to the Agavaceae (also Asparagaceae and Amaryllidaceae according to some botanists) family, which is planted in Bangladesh in home gardens. The plant is also cultivated commercially for its fragrant flowers. Various folk medicinal uses of the plant include being used for tumor, cosmetic, laxative, cooling, placebo, sexual disorder, hair color, emetic, diuretic, and gonorrhea. The plant contains a number of flavonoids and other polyphenols, which can be of possible therapeutic use against a number of diseases resulting from or causing oxidative stress like diabetes, rheumatoid arthritis and cardiovascular disorders. Pharmacological studies indicate that the plant has anti-microbial, anti-oxidant, anti-viral, immunomodulatory, diabetic wound healing, anti-inflammatory, anti-amebic, anti-ulcer, and neuropharmacological properties. The presence of bioactive principles combined with the traditional uses and reported pharmacological properties of the plant indicate that the plant can be considered an important source for lead compounds and new drugs.

Keywords: *Polianthes tuberosa*, Acanthaceae, glucosides, anti-microbial, anti-amebic

Introduction
Polianthes tuberosa L. is a flowering plant belonging to the Agavaceae family (also Asparagaceae and Amaryllidaceae according to some botanists). In English, the plant is known as 'Double Pearl Tuberose', locally the plant is known as 'Rojonigondha'. It is a grass-like plant with underground storage bulb. Leaves are green; the flowering stem rises taller than the leaves and bears white fragrant flowers. Ethnomedicinal uses in Bangladesh include use as or treatment for tumor, cosmetic, laxative, cooling, placebo, sexual disorder, hair color, emetic, diuretic, and gonorrhea [1]. As such, it was of interest to review the plant with the objective of finding out the plant's potential as a therapeutic agent. For purposes of this review, appropriate searches were conducted in PubMed, SCOPUS and other indexing bodies without any limitation to year limits.

Taxonomic hierarchy of *Polianthes tuberosa*

Kingdom	Plantae
Sub-kingdom	Tracheobionta
Division	Magnoliophyta
Class	Liliospida
Sub-class	Liliidae
Order	Liliales
Family	Agavaceae
Genus	*Polianthes*
Species	*Polianthes tuberosa* L.

Ethnomedicinal uses of the plant or plant parts
The various ethnomedicinal uses of the plant in Bangladesh are shown in Table 1 and partly compiled from sources as mentioned in the References section [1]. Other uses were obtained from data collected from folk medicinal practitioners of Bangladesh residing in different districts but the data is yet to be published. The plant or parts of the plant also has medicinal uses in other countries apart from Bangladesh. The plant is used for gonorrhea, insomnia and low sex drive by people of Kollihills, Namakkal district, Tamil Nadu, India [2]. Flowers are taken as tea in Dominican Republic for women's health conditions [3].

Since a major traditional use of the plant is against gonorrhea, and since the causative organism *Neisseria gonorrhea* is developing antibiotic resistance [4], the plant may prove to be a new source for discovery of anti-gonorrheal drugs.

Table 1: Ethnomedicinal uses of *Polianthes tuberosa* in Bangladesh.

Scientific and English names	Family	Local names	Parts used	Ailments treated/Uses
Polianthes tuberosa L. syn. *Agave polianthes* J. Thiede & U. Eggli, *Polianthes tubulata* Sessé & Moc., *Polianthes gracilis* Link English: Tuberose	Agavaceae	Rojonigondha	Root, stem, flower, whole plant	Tumor, cosmetic, laxative, cooling, placebo, sexual disorder, hair color, emetic, diuretic, gonorrhea.

Reported phytochemicals and pharmacological activities

From the aerial parts of the plant, a new bisdesmosidic cholestane glycoside has been isolated along with three new spirostanol saponins and a cholestane glycoside [5]. Three glycosides and a long chain alcohol has been isolated from the bulbs of the plant, which were identified as 3,29-dihydroxystigmast-5-ene-3-*O*-β-D-galactopyranoside, ethyl-β-D-galactopyranoside, ethyl-α-D-galactopyranoside, and 1-tricosanol [6]. Phytochemical analysis of the underground parts of the plant resulted in isolation of four new spirostanol saponins with five monosaccharides [7]. Six new steroid glycosides – two spirostanols, polianthosides B and C, and four furostanols, polianthosides D-G has been isolated from fresh tubers of the plant together with seven known spirostanols and a known furostanol saponins [8]. The leaves have further been reported to contain a tuberolactone and three flavonoids (kaempferol, kaempferol-3-*O*-xyloside and kaempferol-3-4'-*O*-dixyloside), 9,10 dehydrohecogenin-3-*O*-glucose xylose galactoside, kaempferol-3-*O*-xyloside, alpha-D-glucoside and polianthosides B and C [9].

Mild anti-fungal activity has been reported for whole plant extract; strong anti-fungal activity has been demonstrated by three phytochemicals constituents present – geraniol, indole, and methyl anthranilate against the mycelial growth of *Colletotrichum gloeosporioides* on potato dextrose-agar medium [10]. The structures of some of the phytochemicals are shown in Figure 1.

Pharmacological activity studies

Geraniol (*trans*-3,7-dimethyl-2,6-octadien-1-ol) has been shown to possess anti-tumor properties. It has been demonstrated to have multiple effects on mevalonate and lipid metabolism in the human hepatocarcinoma cell line, Hep G2. The growth rate and 3-hydroxymethylglutaryl coenzyme A reductase (HMG-CoA reductase) activity of Hep G2 cells were also inhibited by geraniol concentrations up to100 micromol/L [11]. The compound has also shown promise against pancreatic cancer, which is generally refractory to chemotherapy. In a study conducted with MIA PaCa-2 human pancreatic cancer cells, three naturally derived isoprenoids – perillyl alcohol, farnesol, and geraniol demonstrated additive anti-proliferative effects. All three compounds induced a G(0)/G(1) cell cycle arrest that coincided with an increase in the expression of the cyclin kinase inhibitor proteins p21 (Cip 1) and p27 (Kip 1) and a reduction in cyclin A, cyclin B1, and cyclin-dependent kinase (Cdk) 2 protein levels [12].

Geraniol also has pharmacological potential in lung inflammatory diseases where oxidative stress is a critical factor. The compound has been shown to protect *t*-BHP (*tert*-butyl hydroxyl peroxide)-stressed rat alveolar macrophages [13].

Essential oil from *Cymbopogon martinii* containing geraniol as the active compound exhibited a broad inhibition spectrum against ten *Escherichia coli* serotypes: three enterotoxigenic, two enteropathogenic, three enteroinvasive and two shiga-toxin producers [14]. The essential oil of *Helichrysum italicum* reportedly significantly reduced the multidrug resistance of *Enterobacter aerogenes*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Acinetobacter baumannii*. Geraniol, a component of the oil was found to significantly increase the efficacy of β-lactams, quinolones, and chloramphenicol [15].

The volatile oil from the leaves and flowers of the same plant, containing geraniol, showed anthelmintic activity by causing paralysis and death of the Indian earthworm *Pheretima posthuma* [16]. The acaricidal activity of the compound (derived from oil of *Pelargonium graveolens* leaves) has also been demonstrated against the storage food mite, *Tyrophagus putrescentiae* [17]. The compound also showed efficacy against fish parasites of the Anisakidae family (*Contracaecum* sp.), which can cause the parasitic disease anisakiasis, when fish is eaten without proper cooking [18]. Field trials conducted in two farms near Rabat (morocco) showed that 1% geraniol has a preventive effect against *Hyalomma* ticks, which affect cattle [19]. Geraniol also showed the longest protection time from mosquito bites when compared with other botanical natural repellents against three mosquito species – *Psorophora ferox*, *Aedes atlanticus*, and *Aedes mitchellae* [20].

Besides geraniol, kaempferol is another phytocomponent of the plant with a large number of attributed beneficial effects and as a consequence, possible therapeutic importance. This review will not attempt to discuss the various pharmacological activities of kaempferol. Briefly, the compound appears to be beneficial in various forms of cancer, Parkinson's disease, diabetes, cardiovascular diseases, arthritis, and erectile dysfunction and as an antioxidant and uterine relaxant [21-28].

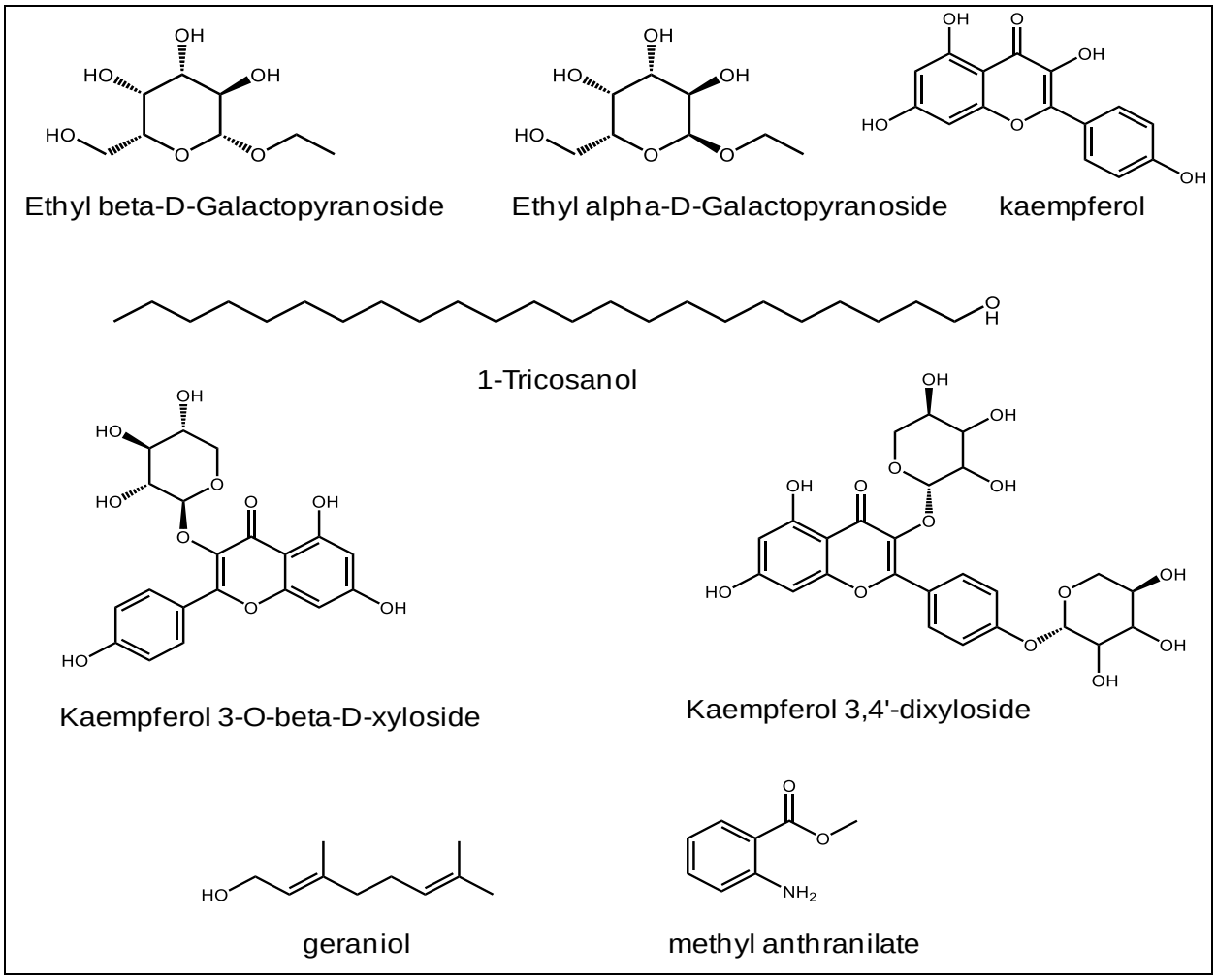

Fig 1: Some phytochemicals isolated from Polianthes tuberosa

Conclusion

Geraniol and kaempferol may prove to be important components of the plant with therapeutic potential, the first against cancer and the second against both cancer and inflammatory diseases [29, 30].

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