Original Research Paper Zoology

CHEMICAL COMPOSITION, ESSENTIAL OILS AND PHARMACOLOGY OF *PELARGONIUM GRAVEOLENS* L.

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ABSTRACT Global population relies on medicinal plant based system of medicine for there health care, a number of herbs/under shrubs of *Pelargonium graveolens* L belongs to family geraniaceae and order geraniales are studied for their medicinal importance.

The phytochemical studies showed that aerial parts of *P. graveolens* contains several bioactive compounds and essential oils viz, monoterpenes, sesquiterpenes, coumarins, tannins, phenolic acids, cinnamic acids, flavones, flavonoids and flavonoids essential oils like geranoids, citronellols, nerol, p-cymene, myrcene, α-pinene and geranyl formate etc showed promosing antioxidant activity, immune modulation, relieves congestion, antodiabetic effect, improves cardiovascular system, helpful for detoxification cure haemorroids are good antimicrobial and antifungal agents.

KEYWORDS : *Pelargonium graveolens L.*, Phytochemistry, Pharmacological Properties, Essential Oils and Bioactive Properties.

INTRODUCTION

Pelargonium graveolens L. species commonly called as rose geranium is one of the 300 species belongs to family Geraniaceae is a native to Northern and Cape provinces of South Africa, Zimbabwe and Mozambique. The term *Pelargonium* is derived from the Greek word "Pelargos" and *graveolens* refers to the strong smell of leaves (Mativandlela et al., 2005).

Several species of *Pelargonium* growing naturally in Australia, Eastern Africa, New Zealand, Middle East and Madagascar (Cavar and Maksimovic, 2011, Herb Society of America, 2006, Hamidpour et al., 2017).

It is annual, biannual and perennial under shrub, erect, multi branched that may grow up to 1.5 m. Leaves are deeply incised, velvety and soft due to presence of glandular hair. The color of flowers is showy from pale pink to white. The scents they produce are due to the occurrence of essential oils in leaves / whole plant. The essential oils are secondary metabolites of plant. Essential oils are volatile natural and complex compounds and attracting insects for seeds and pollens dispersal and pollination therefore important for plant reproduction. The essential oil obtained is economically and medicinally important (Ghannadi et al., 2012, Hamidpour et al., 2017).

The extract of *P. graveolens* is used as traditional medicine, tanning and dying (Davis, 1967, Mousavi et al., 2014). The present review aims at exploring the current scientific findings about phytochemistry and Pharmacology of *P. graveolens* L.

Important Species of *Pelargonium*

There are following important species of *Pelargonium* reported by (Saraswathi et al., 2011)

P. betulinum, P. capitatum, P. citronellum, P. citronellum, P. cordifolium, P. crispum, P. cucullatum, P. cucullatum, P. glutinosum, P. glutinosum, P. graveolens, P. greytonense, P. hermanniifolium, P. hispidum, P. panduriforme, P. panduriforme, P. papilionaceum, P. pseudoglutinosum, P. quercifolium, P. quercifolium, P. radens, P. scrabroide, P. scabrum, P. sublignosum, P. tomentosum, P. vitifolium, P. hortorum.

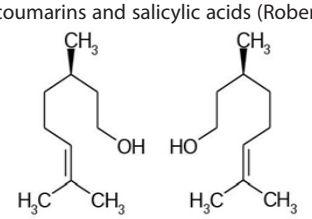
Phytochemical Compounds and Essential Oil Components of *Pelargonium graveolens L.*

As reported by Ayo, 2010 the natural bioactive compounds in Pelargonium are Pelargonin, Malvidin diglucoside abd indole alkaloids have been indentified. It was conformed that flavonols are the basic constituents of flavonoids (Bakker et al., 2004, William et al., 2000 and Saraswathi et al., 2011).

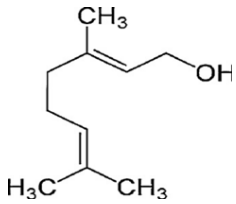
Investigations on essential oil chemical composition revealed the presence of 230 components including mixture of over 120 monoterpenes and sesquiterpenes such as pinene, phellanclrene, myrcene, limonene, germacrene and caryophyllene (Williams and Harborne 2002, Vernine et al., 1983, Verma et al., 2010) and the other compounds identified as terpene, alcohols, esters, aldehydes, ketones and phenols etc. The main components of essential oil are citronellol, geraniol, Cis -3-Hexenol*, a-Pinene*, 6-Methyl-5-heptene-2-one*, Myrcene*, a-phelleandrene*, p-Cymene*, Limonene*, Cis-b-Ocimene*, Trans-b-Ocimene*, Cis –Linalool oxide*, Terpinolene*, Trans-Linalool oxide*, Linool*, Cis-Rose oxide*, Trans –Rose oxide*, Menthone*, Citronellal, Iso-isopulegol, Isomenthone*, Terpinen-4-ol*, Neoisomenthol, a-terpineol*, Nerol*#, Citronellol*#, Neral, Piperitone, Geranio*, Geranial*, Citronellyi formate* , Geranyl formate *, a-Cubebene*, Phenylethyl propanoate, Citronellyl acetate, a-Copene*, a-Ylangene*, b-Bourbonene*, Geranyl acetate b-Caryophyllene*, Trans-a-bergamotene, Aromadendrene, a-Guaiene , a-Humulene*, Alloarmadendrene*, Citronellyl, propanoate*, Germacrene D*, g-Muurolene*, Geranyl propanoate*, d-Cadinene*, Cis-Calamenene*, Citronellyl-n-butyrate*, a-Agarofuran, Germacrene B, Geranyl–n-butyrate*, Phenylethyl tiglate*, 10-Epi-g-eudesmol*,, Hinesol, g-Eudesmol, Gerany valerate, Geranyl tiglate, Citronellyl hexanoate, Geranyl hexanote*, Citronellyl, heptanoate, Geranyl heptanoate*, Geranyl octanoate*, Geranyl octanoate*, Cyclofebcheh, p-methone, Geraniol, 0-octen-1-01, Geranio 11, β-cariophyllene, Germacrene-D, Phenyl ethyl tiglate, Caryophyllene oxide, Genaryl tiglate.

As reported by Neetu Jain et al., 2001; Robert et, al., 2003, Jain et al., 2001; Robert et al., 2003, Elham et al., 2014.

Further chemical analysis have led to the identification of about 65 metabolites including phenolic acid, cinnamic acids, tannins flavonoids, coumarins and salicylic acids (Robert and Philip 2003).



Molecular Structure of citronellol



Molecular Structure of geraniol

Pharmacological Properties

P. graveolens may be called rose geranium, it is cultivated on a large scale and its foliage is distilled for essential oils, commonly called geranium oil widely used for aromatherapy and massage therapy also as a flavoring agents, flowers and leaves are used in cakes, jams, jellies, ice creams, salad, tea and sugars.

Recently many investigators reported about composition, biological effects, medicines, food flavoring, perfumery and cosmetics (Lawrence, 1978, Mosavi et al., 2014). Essential oils are widely used in pharmaceutical industries. Several reports are available to prove that *P. graveolens* contains novel therapeutic agent as listed below:

1. Antioxidant Properties: Free radical biology revealed that reactive oxygen species are key factors in development of certain human diseases include cancer, diabetes and cardiovascular disease and early aging which can be prevented by the use of natural antioxidants occurring in *P. graveolens* stems and leaves possessed higher antioxidant activity (Caver and Maksimovic, 2011, Boukhris et al., 2012, Saraswathi et al., 2011, Fayed, 2009).

2. Antimicrobial Properties: The essential oil of *P. graveolens* showed significant antibacterial activity against *Staphylococus aureus, B. subtilis, Proteus vulgaris, C. albicans, C. glabrata, C. neoformans, Mycobacterium sp*. and Lactobacilli etc (List et al., 1998, Schwiertz et al., 2006, Seidel and Taylor, 2004, Mativandlela et al., 2006, Serkedjieva, 1997, Derwich et al., 2010, Gabriella et al., 2010, Stjepan et al., 2005). It was reported that presence of α-pinene, β-pinene showed promising activity to inhibit bacterial growth (Derwich et al., 2010 and Gabriella et al., 2010). It has wound healing properties (List et al., 1996, Stjepan et al., 2005). The broad spectrum antibacterial activity may be caused by coumarins and phenolic acids (Verma et al., 2010).

The essential oil of this plant is also broad spectrum fungitoxic against *Aspergillus fumigates, A. flavus, A. niger, A. terreus, A. alternate, Fusarium oxysporium, Penicillium notatum* and completely inhibited aflatoxin B production (Helal et al., 2007, Kwon and Ahn, 2002).

3. Acaricidal Activity: The dust mites allergens can cause allergic rhinitis, intrinsic allergy alveolitis and extrinsic allergy alveolitis and pulmonary inflammation as most of the houses co-inhibated by mite *Dermatophagoides farinae*, the use of *P. graveolens* essential oils can inhibit such mites. Reports are available that gerniol and β-citronellol contents of essential oil fumigation is useful in removing and killing of mite allergens (Ju-Hyun et al., 2008).

4. Anticancer and Antitumor Activity: It was reported that geranium essential oil has potential antitumor and anticancer activity against uterine cervical neoplasia, HL-60 and NB-$_4$ cell lines thus highly cytotoxic in nature. It is also effective against human promyelocytic leukemia cells at LC_{50} values of 62.5 µg/ml.

The anticancer activity is due to the presence of monoterpenes. Analysis of geranium essential oil has shown citronellol and trans-geraniol as major constituents posses strong anticancer activity against pancreatic tumor cells (Fayed, 2009, Bruke et al., 1997).

Geranium essential oil is also popular for treatment of dysentery, hemorrhoids, inflammations, and heavy menstrual flow in human female.

5. Antiplasmodial Activity: The non-volatile extracts of *Pelargonium sp.* showed excellent antimalarial activity against *plasmodium falciparum.*

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