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The therapeutic potential of *Notobubon galbanum*: a review of its medicinal uses and phytochemistry

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Abstract

Notobubon galbanum is a woody evergreen shrub widely used as traditional medicine in South Africa. The present review aims to provide a comprehensive review of the medicinal uses and phytochemistry of *N. galbanum*. Diverse electronic search engines and specialized reference tools such as Google, Google Scholar, Scopus, Web of Science, scientific literature, publishing sites and electronic databases (Pubmed, Springer, Wiley and Science Direct) were used for data retrieval. The leaves and stems of *N. galbanum* are used as abortifacient and as traditional medicine to treat and manage dropsy, vesical catarrh, rheumatism, glandular swelling, high blood pressure, water retention, obesity, bladder ailments and kidney infections. The major compounds identified from the aerial parts, fruits, leaves and stems of *N. galbanum* include p-cymene, 3-methyl-2-isobutyl pyrazine, 3-methyl-2-buten-1-ol, 2, methyl, 1-hexen-4-yne, 3-ethylidene, methyl acetophenone, myrcene, (E)-β-ocimene, β-pinene, γ-terpinene, 2,4(10)-thujadiene, α-thujene and xanthotoxin. There is need for detailed studies focusing on biological activities, safety and clinical relevance of crude extracts and compounds isolated from *N. galbanum.*

Keywords: Apiaceae, ethnopharmacology, herbal medicine, indigenous pharmacopeia, *Notobubon galbanum*, Umbelliferae

INTRODUCTION

Notobubon galbanum (L.) Magee is a woody evergreen shrub belonging to the Apiaceae or Umbelliferae family. This is a plant family of mostly aromatic flowering plants such as carrot (*Daucus carota* L.), celery (*Apium graveolens* L.) and parsley (*Petroselium crispum* (Mill.) Fuss. The genus name "*Notobubon*" is a contraction of two terms, the Greek term "*noto*" which means "southern", alluding to the genus's southern African origin[1] and "*bubon*", mainly because many *Notobubon* B.-E. Van Wyk species were once members of the genus *Bubon* L.[2] The specific epithet "*galbanum*" indicates that at the time of its description, this species was erroneously considered to be the species from which one of the oldest recorded medicines "*galbanum*" was obtained.[2] The genus *Notobubon* consists of 12 species that are subendemic to the Cape Floristic Region of South Africa with only one species, *N. laevigatum* (Aiton) Magee extending its distributional range along the eastern parts of South Africa into Lesotho and Swaziland.[1,3] *Notobubon galbanum* has been recorded in the Fynbos biome in moist, rocky or stony, sandy or clay soils from Elands Bay to the Cape Peninsula and east to Albertinia in the Western Cape province at an altitude of about 100 m above sea level.[1,4,5] The English common names of *N. galbanum* include "blister bush", "hog's funnel" and "wild celery". The name "blister bush" is derived from the fact that contact with *N. galbanum* results in blistering of the skin,[6,7] while the name "wild celery" is because the species is in the same family as the well-known and widely cultivated aromatic vegetable fennel, *Foeniculum vulgare* Mill. Synonyms associated with the name *N. galbanum* include *Agasyllis galbanum* (L.) Spreng., *Bubon galbaniferum* Hill, *B. galbanum* L., *B. galbanum* L. var. *galbanum*, *B. galbanum* L. var. *tulbaghicum* Eckl. & Zeyh., *Galbanon officinale* Raf., *Peucedanum galbanum* (L.) Drude, *P. galbanum* (L.) Benth. & Hook. f., *P. galbanum* (L.) Drude var. *dentatum* Kuntze, *P. galbanum* (L.) Drude var. *galbanum*, *P. galbanum* (L.) Drude var. *incisodentatum* Kuntze and *Selinum galbanum* (L.) Spreng.[1,4]

Notobubon galbanum is a slender, robust and erect shrub growing up to 3 metres in height with a strong resinous smell.[1,4,7] The stems of *N. galbanum* are solitary and sparsely branched above the ground level with glabrous branches. The leaves of *N. galbanum* are compound, regularly arranged along the upper parts of the branches and consist of toothed, rhombidal and occasionally three-lobed leaflets that are green above and glaucous below. The flowers are small and yellow in colour and borne in large, round compound umbels on relatively short peduncles. The fruit is dry and dorsally flattened with narrow wings along the margins. The large size and distinctive shape of the leaflets make it easy to distinguish *N. galbanum* from other related species of the family.[1,7]

Medicinal uses of *Notobubon galbanum*

The leaves and stems of *N. galbanum* are used as abortifacient and as traditional medicine to treat and manage dropsy, vesical catarrh, rheumatism, glandular swelling, high blood pressure, water retention, obesity, bladder ailments and kidney infections (Table 1, Figure 1). Other medicinal applications of *N. galbanum* supported by less than five literature records include arthritis, chest complaints, colds, diabetes, diuretic, gout, gravel, jaundice, magical purposes, miscarriage, post-partum to expel retained placenta, prostrate problems, renal diseases and tuberculosis (Table 1). The leaves of *N. galbanum* are mixed with whole plant parts of *Chironia baccifera* L. as herbal medicine for arthritis.[2,8,9] The leaves of *N. galbanum* are mixed with those of *Diosma vulgaris* Schltr. var. *longifolia* Sond. as herbal medicine for dropsy and renal diseases.[2,10-13] The leaves of *N. galbanum* are mixed with those of *Mentha longifolia* Huds. and *Pelargonium grossulariodes* Ait. for suppression of menses.[2,11-13] Due to its popularity as herbal medicine, the leaves and stems of *N. galbanum* are sold in informal herbal medicine markets

as sources of traditional medicines in the Eastern Cape and Western Cape provinces of South Africa.[14-16]

Phytochemistry of *Notobubon galbanum*

The major compounds that have been identified from the aerial parts, fruits, leaves and stems of *N. galbanum* (Table 2) include p-cymene (3.3% – 64.6%), 3-methyl-2-isobutyl pyrazine (14.0%), 3-methyl-2-buten-1-ol (5.9%), 2, methyl, 1-hexen-4-yne, 3-ethylidene (16.8%), methyl acetophenone (9.1%), myrcene (0.1% – 7.9%), (E)-β-ocimene (0.9% – 17.0%), β-pinene (<0.4% – 31.0%), γ-terpinene (1.9% – 15.0%), 2,4(10)-thujadiene (5.4%), α-thujene (4.9% - 14.3%) and xanthotoxin (5.0%).[6,12,13,18,27] The compounds bergapten, psoralen, xanthotoxin and other furanocoumarins identified from various parts of *N. galbanum* are categorized as moderately hazardous mainly as cell toxins and causing inflammatory and mutagenic effects.[18] The compound, xanthotoxin is known to cause severe light-induced dermatitis[6] and skin blistering effect (vesiculation) is caused by bergapten, psoralen and xanthotoxin.[6] The infusion of *N. galbanum* is a diaphoretic and produces dermatitis and blisters, that is, vesicant effect after 40 hours to 50 hours after contact with the plant with bare skin.[10]

Table 1: Medicinal uses of *Notobubon galbanum*

Medicinal use	Parts used	Reference
Abortifacient	Leaves	Watt and Breyer-Brandwijk[10]; Jackson[11]; Finkelstein et al.[12]; Campbell et al.[13]; Sarkhail[17]
Arthritis	Leaves	Van Wyk and Gericke[8]; Van Wyk and Gericke[9]
Arthritis	Leaves mixed with whole plant parts of *Chironia baccifera* L.	Magee[2]; Van Wyk and Gericke[8]; Van Wyk and Gericke[9]
Bladder ailments	Leaves and stems	Magee et al.[1]; Van Wyk et al.[6]; Van Wyk et al.[7]; Magee[2]; Van Wyk and Gericke[8]; Van Wyk and Gericke[9]; Watt and Breyer-Brandwijk[10]; Jackson[11]; Finkelstein et al.[12]; Campbell et al.[13]; Sarkhail[17]; Wink and Van Wyk[18]; Nzue[19]
Chest complaints	Leaves and stems	Nzue[19]
Colds	Leaves	Van Wyk and Gericke[8]; Van Wyk and Gericke[9]
Diabetes	Leaves and stems	Nzue[19]; Philander[20]
Diuretic	Leaves	Magee[2]; Philander[20]; Van Wyk[21]; Van Wyk and Gorelik[22]
Dropsy	Leaves mixed with *Diosma vulgaris* Schltr. var. *longifolia* Sond.	Magee[2]; Watt and Breyer-Brandwijk[10]; Jackson[11]; Finkelstein et al.[12]; Campbell et al.[13]
Glandular swelling	Leaves and stems	Van Wyk et al.[7]; Watt and Breyer-Brandwijk[10]; Jackson[11]; Finkelstein et al.[12]; Campbell et al.[13]; Sarkhail[17]; Nzue[19]
Gout	Leaves	Magee et al.[1]; Magee[2]; Van Wyk and Gericke[8]; Van Wyk and Gericke[9]
Gravel	Leaves	Van Wyk[21]; Van Wyk and Gorelik[22]
High blood pressure	Leaves and stems	Magee et al.[1]; Magee[2]; Van Wyk et al.[7]; Watt and Breyer-Brandwijk[10]; Nzue[19]; Philander[20]; Balogun and Ashafa[23]
Jaundice	Leaves	Parsley[24]
Kidney infections	Leaves and stems	Van Wyk et al.[6]; Van Wyk et al.[7]; Van Wyk and Gericke[8]; Van Wyk and Gericke[9]; Watt and Breyer-Brandwijk[10]; Jackson[11]; Finkelstein et al.[12]; Campbell et al.[13]; Sarkhail[17]; Wink and Van Wyk[18]; Nzue[19]; Manning et al.[25]; Van Jaarsveld[26]
Magical purposes (suppression of menses)	Leaves mixed with *Mentha longifolia* Huds. and *Pelargonium grossulariodes* Ait.	Magee[2]; Jackson[11]; Finkelstein et al.[12]; Campbell et al.[13]
Miscarriage	Leaves	Finkelstein et al.[12]
Obesity	Leaves and stems	Magee[2]; Van Wyk et al.[6]; Van Wyk et al.[7]; Van Wyk and Gericke[8]; Van Wyk and Gericke[9]; Wink and Van Wyk[18]; Nzue[19]; Philander[20]; Van Wyk[21]; Van Wyk and Gorelik[22]
Post-partum to expel retained placenta	Leaves	Finkelstein et al.[12]
Prostrate problems	Leaves	Jackson[11]; Finkelstein et al.[12]; Campbell et al.[13]; Sarkhail[17]
Renal diseases	Leaves mixed with *Diosma vulgaris* Schltr. var. *longifolia* Sond.	Magee[2]; Jackson[11]; Finkelstein et al.[12]; Campbell et al.[13]
Rheumatism	Leaves	Magee et al.[1]; Van Wyk et al.[7]; Watt and Breyer-Brandwijk[10]; Philander[20]; Manning et al.[25]; Van Jaarsveld[26]
Tuberculosis	Leaves	Parsley[24]
Vesical catarrh	Leaves	Watt and Breyer-Brandwijk[10]; Jackson[11]; Finkelstein et al.[12]; Campbell et al.[13]; Sarkhail[17]
Water retention	Leaves and stems	Magee et al.[1]; Magee[2]; Van Wyk et al.[7]; Watt and Breyer-Brandwijk[10]; Jackson[11]; Finkelstein et al.[12]; Campbell et al.[13]; Sarkhail[17]; Nzue[19]

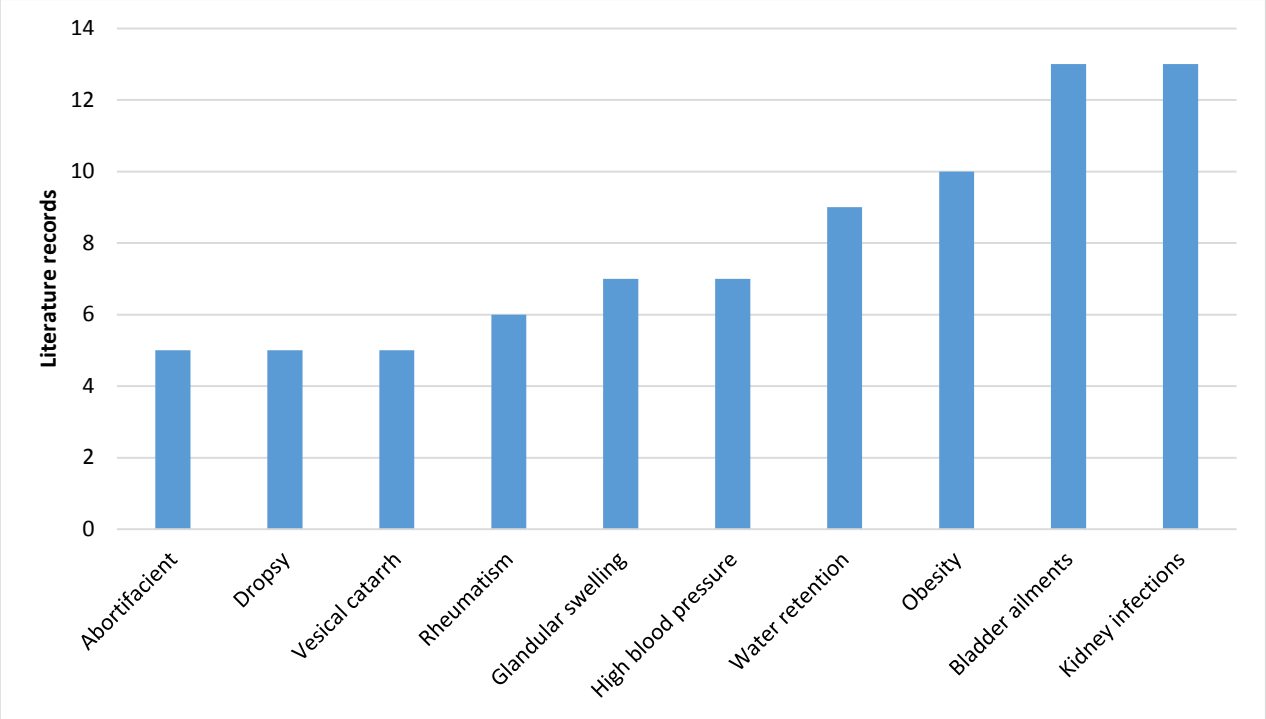

Figure 1. Medicinal applications of *Notobubon galbanum* derived from literature records

Table 2: Phytochemical composition of *Notobubon galbanum*

Phytochemical	Value	Plant part	Reference
Benzaldehyde (%)	0.2	Aerial parts	Campbell et al.[13];
Benzophenone (%)	0.9	Aerial parts	Campbell et al.[13]
Benzyl isobutyl ketone (%)	0.7	Fruits	Sobiyi et al.[27]
Bergapten	-	Aerial parts	Van Wyk et al.[6]; Finkelstein et al.[12]; Wink and Van Wyk[18]
Bourbonene (%)	0.8	Aerial parts	Campbell et al.[13]
Butyl (E)-2-methyl-2-butenoate (%)	2.3	Aerial parts	Campbell et al.[13]
Butyl (Z)-2-methyl-2-butenoate (%)	2.0	Aerial parts	Campbell et al.[13]
δ-cadinene (%)	0.8	Aerial parts	Campbell et al.[13]
Camphene (%)	0.1 – 0.2	Fruits	Sobiyi et al.[27]
Car-3-ene (%)	0.2	Aerial parts	Campbell et al.[13]
trans-3-caren-2-ol (%)	0.1	Fruits	Sobiyi et al.[27]
1,8-cineole (%)	0.1 – 0.4	Fruits	Sobiyi et al.[27]
Cinnamyl pentanoate (%)	1.3	Aerial parts	Campbell et al.[13]
Cinnamyl (E)-2-methyl-2-butenoate (%)	1.4	Aerial parts	Campbell et al.[13]
Cinnamyl (Z)-2-methyl-2-butenoate (%)	2.3	Aerial parts	Campbell et al.[13]
β-cubebene (%)	1.3	Leaves and stems	Sobiyi et al.[27]
Cumin aldehyde (%)	0.3	Aerial parts	Campbell et al.[13]
Cycloisolongifolene (%)	1.4	Leaves and stems	Sobiyi et al.[27]
Cyclopentylethanol (%)	0.3	Fruits	Sobiyi et al.[27]
m-cymene (%)	0.2	Fruits	Sobiyi et al.[27]
o-cymene (%)	0.7	Fruits	Sobiyi et al.[27]
p-cymene (%)	3.3 – 64.6	Aerial parts, fruits and stems	Campbell et al.[13]; Sobiyi et al.[27]
2,4-dimethylfuran (%)	0.2	Aerial parts	Campbell et al.[13]
α,p-dimethylstyrene (%)	2.0	Aerial parts	Campbell et al.[13]
Eugenol (%)	0.3	Aerial parts	Campbell et al.[13]
trans-β-farnesene (%)	0.9	Aerial parts	Campbell et al.[13]
Heptyl ethanoate (%)	0.5	Aerial parts	Campbell et al.[13]
Hexanal (%)	0.3	Fruits	Sobiyi et al.[27]
cis-2-hexenal (%)	0.4	Aerial parts	Campbell et al.[13]
cis-3-hexenol (%)	0.2	Aerial parts	Campbell et al.[13]
trans-2-hexenal (%)	0.6	Aerial parts	Campbell et al.[13]
trans-3-hexen-1-ol (%)	1.4	Fruits	Sobiyi et al.[27]
Hexy 3-methylbutanoate (%)	0.5	Aerial parts	Campbell et al.[13]

Hexy (E)-2-methyl-2-butanoate (%)	1.2	Aerial parts	Campbell et al.[13]
Hexy (Z)-2-methyl-2-butanoate (%)	1.8	Aerial parts	Campbell et al.[13]
Isobutyl angelate (%)	0.4	Fruits	Sobiyi et al.[27]
Isobutyl 3-methylbutenoate (%)	0.3	Aerial parts	Campbell et al.[13]
Isobutyl (Z)-2-methyl-2-butenoate (%)	3.1	Aerial parts	Campbell et al.[13]
Isobutyl tiglate (%)	0.1 – 0.6	Fruits, leaves and stems	Sobiyi et al.[27]
Isopentyl (Z)-2-methyl-2-butenoate (%)	1.6	Aerial parts	Campbell et al.[13]
Linalool (%)	2.7	Aerial parts	Campbell et al.[13]
p-menthatriene (%)	1.0	Aerial parts	Campbell et al.[13]
p-mentha-1,3,8-triene (%)	0.2	Aerial parts	Campbell et al.[13]
p-mentha-1(7),2-diene-8-ol (%)	0.6	Aerial parts	Campbell et al.[13]
p-menthylacetophenone (%)	0.3	Aerial parts	Campbell et al.[13]
p-mentha-1,5-dien-8-ol (%)	0.3	Aerial parts	Campbell et al.[13]
2-methoxybenzyl alcohol (%)	4.1	Fruits	Sobiyi et al.[27]
trans-2-methyl-2-butenal (%)	0.3	Aerial parts	Campbell et al.[13]
2-methyl butyrate (%)	0.1	Fruits	Sobiyi et al.[27]
Methyl eugenol (%)	0.3 – 0.6	Aerial parts, leaves and stems	Campbell et al.[13]; Sobiyi et al.[27]
3-methyl-2-isobutyl pyrazine (%)	14.0	Fruits	Sobiyi et al.[27]
Methyl isoeugenol (%)	0.3	Aerial parts	Campbell et al.[13]
3-methyl-2-buten-1-ol (%)	5.9	Fruits	Sobiyi et al.[27]
2, methyl, 1-hexen-4-yne, 3-ethylidene (%)	16.8	Fruits	Sobiyi et al.[27]
Methyl acetophenone (%)	9.1	Fruits	Sobiyi et al.[27]
Methyl chavicol (%)	0.1	Fruits	Sobiyi et al.[27]
Myrcene (%)	0.1 – 7.9	Aerial parts, fruits, leaves and stems	Campbell et al.[13]; Sobiyi et al.[27]
Nonan-4-one (%)	3.9	Aerial parts	Campbell et al.[13]
Nonane (%)	0.2 – 0.7	Fruits	Sobiyi et al.[27]
3-nonene (%)	2.0	Fruits	Sobiyi et al.[27]
α-ocimene (%)	0.9 – 1.0	Fruits	Sobiyi et al.[27]
(E)-β-ocimene (%)	0.9 – 17.0	Leaves and stems	Sobiyi et al.[27]
(Z)-β-ocimene (%)	0.4 – 4.8	Leaves and stems	Sobiyi et al.[27]
Z-β-ocimene (%)	0.4	Fruits	Sobiyi et al.[27]
trans-β-ocimene (%)	4.3	Aerial parts	Campbell et al.[13]
Octyl (Z)-2-methyl-2-butenoate (%)	0.5	Aerial parts	Campbell et al.[13]
Pentyl (E)-2-methyl-2-butenoate (%)	1.0	Aerial parts	Campbell et al.[13]
β-phellandrene (%)	0.8 – 2.4	Fruits	Sobiyi et al.[27]
α-pinene (%)	0.6 – 1.4	Leaves and stems	Sobiyi et al.[27]
β-pinene (%)	<0.4 – 31.0	Aerial parts, fruits, leaves and stems	Campbell et al.[13]; Sobiyi et al.[27]
Propyl(E)-2-methyl-2-butenoate (%)	0.4	Aerial parts	Campbell et al.[13]
Propyl(Z)-2-methyl-2-butenoate (%)	0.2	Aerial parts	Campbell et al.[13]
Psoralen (%)	3.3	Aerial parts	Van Wyk et al.[6]; Finkelstein et al.[12]; Campbell et al.[13]; Wink and Van Wyk[18]
Sabinene (%)	0.9 – 4.0	Fruits, leaves and stems	Sobiyi et al.[27]
Sabinol (%)	0.1	Aerial parts	Campbell et al.[13]
Santolina triene (%)	0.3	Fruits	Sobiyi et al.[27]
Sesquiterpene hydrocarbon (%)	1.3	Aerial parts	Campbell et al.[13]
Spathulenol (%)	0.9	Aerial parts	Campbell et al.[13]
α-terpinene (%)	0.9 – 3.9	Fruits	Sobiyi et al.[27]
γ-terpinene (%)	1.9 – 15.0	Fruits, leaves and stems	Sobiyi et al.[27]
α-terpineol (%)	0.4	Aerial parts	Campbell et al.[13]
Terpinolene (%)	1.3 – 1.4	Fruits	Sobiyi et al.[27]
2,4(10)-thujadiene (%)	5.4	Fruits	Sobiyi et al.[27]
α-thujene (%)	4.9 – 14.3	Fruits	Sobiyi et al.[27]
cis-thujone (%)	0.1	Fruits	Sobiyi et al.[27]
Thymol (%)	0.8	Aerial parts	Campbell et al.[13]
Z-3-undecene (%)	0.1	Fruits	Sobiyi et al.[27]
Xanthotoxin	5.0	Aerial parts	Van Wyk et al.[6]; Finkelstein et al.[12]; Campbell et al.[13]; Wink and Van Wyk[18]
m-xylene (%)	0.8	Aerial parts	Campbell et al.[13]
o-xylene (%)	0.3	Aerial parts	Campbell et al.[13]
p-xylene (%)	0.2	Aerial parts	Campbell et al.[13]

CONCLUSION

Research on *N. galbanum* over the past decades focused on its traditional uses and phytochemistry as contact with the species followed by exposure to sunlight resulted in severe blistering. Such research resulted in the identification of volatile oils and several furanocoumarins such as bergapten, psoralen and xanthotoxin. More research in this regard is required and future research should focus on biological activities of both crude extracts and chemical compounds isolated from the species. Such research should focus on the mechanisms of action of its bioactive constituents to illustrate the correlation between ethnomedicinal uses and pharmacological activities of the species. There is need for extensive in vivo experiments as a mechanism to assess the clinical relevance of the species. Since, *N. galbanum* contains potentially toxic compounds, its toxicological properties should be evaluated as the species is widely used as herbal medicine.

Conflict of interest

The author declares that he has no conflict of interest.

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