



REVIEW PAPER

Wojciech Domka ¹(ABDGF), David Aebisher ²(ABDGF), Zuzanna Bober ³(AB),
Łukasz Ożóg ⁴(AB), Dorota Bartusik-Aebisher ⁵(ABCDGF)

The potential of phytotherapy in otorhinolaryngology

¹ Department of Otolaryngology, Faculty of Medicine, University of Rzeszów, Poland

² Department of Human Immunology, Faculty of Medicine, University of Rzeszów, Poland

³ Department of Electroradiology, Faculty of Medicine, University of Rzeszów, Poland

⁴ Centre for Innovative Research in Medical and Natural Sciences, Faculty of Medicine,
University of Rzeszów, Poland

⁵ Department of Experimental and Clinical Pharmacology, Faculty of Medicine, University of Rzeszów, Poland

Abstract

Introduction. The objective of this paper is to review the evidence of the use of herbs in phytotherapy.

Aim. To discuss plant properties and applications in otorhinolaryngology.

Materials and methods. We analysed literature and collected information of phytotherapy in otorhinolaryngology.

Results. The databases were searched using various keywords such as phytotherapy, otorhinolaryngology, and herbs such as: echinacea, eucalyptus, garlic, ginkgo, ginseng, kava, pelargonium sidoides, rosemary, spirulina, St John's wort, and thyme.

Conclusions. Due to the beneficial impact of medicinal plants in medicine there is a growing interest in analytical identification and quantification for clinical medicine and forensic toxicology.

Keywords. phytotherapy, medicinal plants, otorhinolaryngology

Introduction to Phytotherapy

The world of plants surrounding us is invariably rich and diverse. Plants serve as a source of food for people and many are known to contain therapeutic phytochemicals. Plants, with the help of assimilatory dyes, can produce organic substances from water and carbon dioxide and other inorganic substances. From year to year, the number of new varieties of plants on the market is growing. In the 18th century, botanist Carl Linnaeus developed an internationally accepted system for nam-

ing each plant and wrote the first International Code of Botanical Nomenclature. The botanical name identifies each plant kingdom, sub-kingdom, division, class, order, family, and species divided into two names which are a genus and species epithet. Botanical names are convenient in communicating plant identification internationally.¹

Thanks to over several thousand years of observation and experience, people have learned to distinguish edible plants from the inedible and even poisonous. Experience also taught them to use the healing properties

Corresponding author: Dorota Bartusik-Aebisher, e-mail: dbartusik-aebisher@ur.edu.pl

Participation of co-authors: A – Author of the concept and objectives of paper; B – collection of data; C – implementation of research; D – elaborate, analysis and interpretation of data; E – statistical analysis; F – preparation of a manuscript; G – working out the literature; H – obtaining funds

Received: 28.09.2018 | Accepted: 16.10.2018

Publication date: September 2018

of certain species. Many medicinal plants were identified by the ancient Sumerians, Assyrians and Egyptians. The Middle Ages did not favor discoveries in the field of herbal medicine as during this period, numerous excesses and beliefs existed in relation to certain plants.

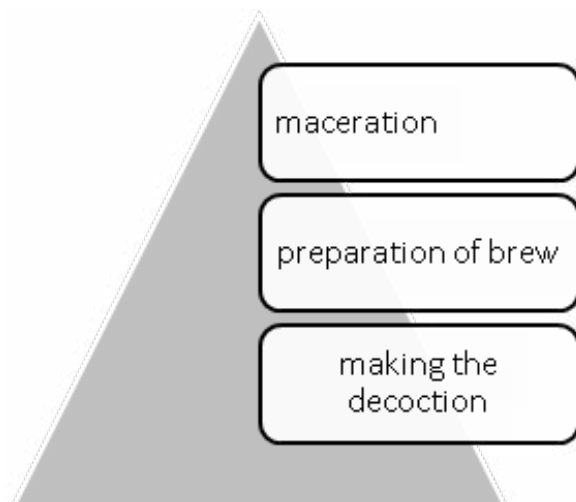


Fig. 1. Three ways to prepare herbal extracts

The healing properties of plants have been known since recorded history. Phytotherapy is a scientific medical method that recently, as part of a return to nature, millions of people around the world are be-

ginning to become interested in. Treatment using phytotherapy should be used wisely and properly under the direction of an experienced doctor or phytotherapist. Little data is available on complementary and alternative medicine use in children attending otolaryngology services.²

Most often, an herb is prepared in the form of freshly-made water extracts. In principle, there are three ways to prepare herbal tea, depending on the type of substances contained in the herbs (Figure 1).

1. maceration – the herbs are flooded with the prescribed amount of cold water and after some time the extract is drained
2. preparation of a brew – the herb is filled with boiling water and leaves under cover for 15 minutes
3. making the decoction – the herb in a covered dish is boiled over low heat.

Herbs consisting of various parts of plants and containing various substances are combined with a combination of, for example, decoction after maceration.

History of otolaryngology, laryngology and otorhinolaryngology

Table 1, Table 2 and Table 3 present a historical listing of a selection of main achievements in otolaryngology, laryngology and otorhinolaryngology respectively.

Table 1. History of otolaryngology

Year	Scientist	Achievements	References
1500 B.C.	-	published chapter titled: "Medications for the hard of hearing"	Nogueira <i>et al.</i> 2007 ¹
-	Empedocles (490-430 B.C.)	described the cochlea as the part of the inner ear involved in hearing	Singer 1957 ³
-	Aristotle (384-322 B.C.)	created a theory on hearing	Gitter 1990 ⁴ , Nogueira <i>et al.</i> 2007 ¹
-	Galeno (129-201 d. C.)	dissected the ears of dogs and monkeys	Nogueira <i>et al.</i> 2007 ¹
1543	Versalio (1514-1564)	described the structure of the malleus and the incus	Nogueira <i>et al.</i> 2007 ¹
-	Gabriel Fallopius (1523-1562)	described the facial nerve canal	Nogueira <i>et al.</i> 2007 ¹
1649	Riolanos	described the technique of mastoidectomy	Nogueira <i>et al.</i> 2007 ¹
1761	Domenico Cotugno (1736-1822)	described the perilymph	Nogueira <i>et al.</i> 2007 ¹
1772	Antonio Scarpa (1752-1832)	described the endolymph	Brackmann <i>et al.</i> 2016 ⁴
1829	Jean Cruveilhier (1791-1874)	described a pearl-like tumor in the central nervous system	Nogueira <i>et al.</i> 2007 ¹
838	Toulemouche	described malignant external otitis	Karaman <i>et al.</i> 2012 ⁵
1860	Evenberg	reported the first case of sudden hearing loss	Nogueira <i>et al.</i> 2007 ¹
1860	Joseph Toynbee (1815-1866)	published "Diseases of the ear"	Nogueira <i>et al.</i> 2007 ¹
1875	Mach	performed pioneering studies on the vestibular excitability threshold	Nogueira <i>et al.</i> 2007 ¹

1883	Adam Politzer (1835-1920)	described auditory dystrophies	Lasmar and Seligman 2004 ⁶
1885	Hermann Schwartz (1837-1910)	published papers systematizing the mastoidectomy technique	Hawkins 2004 ⁷
1889	Emanuel Zaufal (1837-1910) and Stacker	described the radical mastoidectomy	Nogueira <i>et al.</i> 2007 ¹
1892	Ernst Julius Richard Ewald (1855-1921)	established the labyrinthine origin of nystagmus	Nogueira <i>et al.</i> 2007 ¹
1894	Adam Politzer (1835-1920)	described the hypoacusis	Lasmar and Seligman 2004 ⁶
1901	Perry	opened the inner ear canal of a patient with Ménière's disease	Lasmar and Seligman 2004 ⁶
1910	Gustave Bondy (1870-1954)	described a surgical technique for apical cholesteatoma with ossicular chain preservation and perforation of the tympanic pars flacida	Nogueira <i>et al.</i> 2007 ¹
1910	Robert Bárány (1876-1936)	successfully trephinated the posterior semicircular canal without opening the antrum	Nogueira <i>et al.</i> 2007 ¹
1912	Harold Albert Kisch (XIX-XX)	described a tympanoplasty for the first time, in a paper published in the "Proceedings of Royal Society"	Nogueira <i>et al.</i> 2007 ¹
1913	Jenkins	trephinated the horizontal semi-circular canal, in an attempt dry the labyrinth	Nogueira <i>et al.</i> 2007 ¹
1914	Robert Bárány (1876-1936)	received the Nobel Prize because of his work on vestibular apparatus physiology and pathology	Nogueira <i>et al.</i> 2007 ¹
1918	Diniz Borges	published a pioneering thesis in Brazil on topics related to the vestibule	Lasmar and Seligman 2004 ⁶
1919	Marcel Lermoyez (1858-1929)	described the syndrome that carried his name with the symptoms	Lasmar and Seligman 2004 ⁶
1920	Harold Gillies (1882-1960)	was the first to use cartilage in remodeling the framework in cases of pinna reconstruction	Chauhan and Guruprasad 2012 ⁸
1921	Carl Nylen (1892-1978)	introduced the monocular microscope for ear surgeries	Nogueira <i>et al.</i> 2007 ¹
1922	Fletcher and Wegel	introduced the audiometric exam in screening patients for hearing loss	Nogueira <i>et al.</i> 2007 ¹
1929	Lüscher	described the middle ear acoustic muscle activity	Møller 1974 ⁹
1932	Charles Ballance (1856-1936) and Arthur Duel (1870-1936)	introduced the facial nerve decompression technique by opening its temporal bone canal	Nogueira <i>et al.</i> 2007 ¹
1934	Schuster	measured for the first time the middle ear impedances	Nogueira <i>et al.</i> 2007 ¹
1940	Boettcher	introduced the electrical burr for mastoid surgery	Nogueira <i>et al.</i> 2007 ¹
1953	Zeiss Optical Company	introduced modern microscopic ear surgery with the development of the binocular microscope	Lasmar and Seligman 2004 ⁶
1954	Edwin Armstrong (1890-1954)	introduced a polyethylene tube in the tympanic membrane, in order to treat cases of serous otitis media	Nogueira <i>et al.</i> 2007 ¹
1967	Sohmer and Feinmesse	attempted to record the electrical activity of the human brainstem	Nogueira <i>et al.</i> 2007 ¹
1968	Aran and Lê Bel	established the basis for electrocochleography	Nogueira <i>et al.</i> 2007 ¹
1970	Jewet, Romano and Wilinston	demonstrated the origin of brainstem potentials	Jewett <i>et al.</i> 1970 ¹⁰
1978	Charles Williams Vaughan (1926-2014)	Laboratory experiments of transoral laryngeal surgery using the CO ₂ laser	Vaughan 1978 ¹¹
1980	Wolfgang Steiner (1942-)	transoral laser microsurgery (TLM) in laryngeal carcinoma	Harris <i>et al.</i> 2017 ¹²
2008	Paolo Macchiarini (1958-)	conducted a transplant of a donated trachea colonized with the stem cells of the recipient	Macchiarini <i>et al.</i> 2008 ¹³
2012	Fatma Tülin Kayhan (1967-)	first successful transoral robotic resection of a laryngeal paraganglioma	Tülin Kayhan <i>et al.</i> 2012 ¹⁴

Table 2. History of Laryngology

Year	Scientist	Achievements	References
1545	Leonardo da Vinci (1452-1519) and Michelangelo di Lodovico Buonarroti Simoni (1475-1564)	performed detailed descriptions of laryngeal function	Nogueira <i>et al.</i> 2007 ¹
1741	Giovanni Battista Morgagni (1682-1771)	described “vocal cords” in the paper “Adversaria Anatomica Prima”	Nogueira <i>et al.</i> 2007 ¹
1745	Exupère-Joseph Bertin (1712-1781)	brought this new concept that the structures described by Ferrein were, in fact, folds, and not cords	Hawkins 2005 ⁷
1806	Philipp Bozzini (1773–1809)	developed an angled speculum with a mirror, used to examine the most varied human cavities	Hawkins 2005 ⁷
1829	Benjamin Ebbington (XVIII-XIX)	carried out a laryngoscopy with a device called “glottiscope”	Nogueira <i>et al.</i> 2007 ¹
1837	Johannes Müller (1801–1858)	described the movement of vocal cords in cadavers	Weir 2000 ¹⁵
1839	James Yearsley (1805-1869)	published the treaty “On throat deafness and the pathological connections of the throat, nose and ear”	Hawkins 2005 ⁷
1865	Morell Mackenzie (1837-1892)	published “The use of the laryngoscope in diseases of the throat”	Hawkins 2005 ⁷
1895	Arthur Schnitzler (1862-1931)	created an impressive atlas of laryngology, used until current times in the University of Vienna	Hawkins 2005 ⁷
1954	Harold Horace Hopkins (1918-1994)	developed optic fibers endoscopes and use to examine the larynx, nasopharynx, nose and pharynx	Weir 2000 ¹⁵
1970	Willard Sterling Boyle (1924-2011) and George Elwood Smith (1930-currently)	charge-coupled device (CCD) chip at the tip of the endoscope	Boyle and Smith 1970 ¹⁶
1975	Mervyn Stuart Strong (1924) and Geza Julius Jako (1930-2015)	first use of CO ₂ laser in patients with early laryngeal cancer	Tahir 2015 ¹⁷
1976	Nobuhiko Isshiki (1930-)	published “Surgeries of the laryngeal framework, thyroplasties”	Weir 2000 ¹⁵
2000	Alan Henry Shikani (XX-XXI) and Abraham Jacob Domb (XX-XXI)	new method of delivery of chemotherapy for the treatment of squamous cell carcinomas (SCCs) of the head and neck	Shikan and Domb 2000 ¹⁸
2017	Abdul Latif Hamadan (XX-XXI)	the first case of a high-fidelity 3D-printed model of the vocal cords	Hamdan <i>et al.</i> 2017 ¹⁹

Table 3. History of otorhinolaryngology

Year	Scientist	Achievements	References
1489	Leonardo da Vinci (1452-1519)	described the nasal conchae and the paranasal sinuses	Nogueira <i>et al.</i> 2007 ¹
1597	Gaspere Tagliacozzi (1546-1599)	published the book “Treaty on Rhinoplasty”	Lascaratos 2003 ²⁰
1651	Nathaniel Highmore (1613–1685)	described the maxillary sinus	Feldmann 1998 ²¹
1707	James Drake (1667–1707) and William Cowper (1666-1709)	described cases of halitosis caused by maxillary sinus suppuration	Feldmann 1998 ²¹
1743	Louis Lamorier (1696–1777)	was already opening the maxillary sinus through the oral cavity	Tange 1991 ²²

1806	Philipp Bozzini (1773-1809)	created Rhinology name	Nogueira <i>et al.</i> 2007 ¹
1806	Johann Nepomuk Czermak (1828-1873)	for the first time mentioned the term "rhinoscopy"	Feldmann 1998 ²¹
1841	Friedrich Gustav Jakob Henle (1809-1885)	studied and differentiated various epithelia	Feldmann 1998 ²¹
1870	Emil Zuckerkandl (1849-1910)	described details of the nose and paranasal sinuses in anatomical studies	Nogueira <i>et al.</i> 2007 ¹
1886	Jan Mikulicz-Radecki (1850-1905)	was the first to describe the opening of the maxillary sinus through the inferior meatus	Nogueira <i>et al.</i> 2007 ¹
1893	George Walter Caldwell (1866-1946)	published his method, which consisted in opening the sinus through the canine fossa, removing the mucosal membrane	Feldmann 1998 ²¹
1897	Henri Luc (1855-1925)	reported his own method, which was practically identical to Caldwell method	Feldmann 1998 ²¹
1959	Walter Messerklinger (1920-2001)	developed the endoscopic technique for diagnosis and surgery of diseases of the nose, sinuses and skull base"	Feldmann 1998 ²¹
1963	Gerard Guiot (1912-1998)	published his experience using the first endoscope with an external light source	Feldmann 1998 ²¹
1970	Gerard Guiot (1912-1998)	the first to use endoscopy for a trans-sphenoidal approach in neurosurgery	Nogueira <i>et al.</i> 2007 ¹
2005	Kubo Shunsuke (XX-XXI)	applied the irrigation-suction straw sheath system originally developed for endoscopic sinus surgery in rhinology, for the endoscopic pituitary surgery	Kubo <i>et al.</i> 2005 ²³
2009	Hitier Martin (XX-XXI)	use of a computer-assisted system in transseptal pituitary surgery	Hitier <i>et al.</i> 2009 ²⁴

Medicinal qualities of plants

Many plants have medicinal qualities and have been used for centuries to cure ailments. Plants such as *Lavender*, *Dill*, *Eucalyptus*, *Marjoram*, *Rosemary*, and *Grape hyacinth* are often grown for scent and are among the most popular smells that people enjoy. *Mimosa* (*Acacia*), *Wax flower* (*Chamelaucium*), *Eucharis*, *Orange Blossom* and *Sweet Lemon Citrus* produce delicate lemon and marzipan scents which are bright and refreshing. *Gardenia*, *Oriental lily*, *Narcissus*, *Stephanotis* and *Tuberose* all have strong exotic scents. Flowers with a floral scent are *Freesia* (a popular flower with a delicate and summery fragrance), *Lily of the valley* (*Convallaria*) (a floral scent that is very popular in beauty products) and *Rose* (the classic floral fragrance). Flowers and plants which have a peppery smell often produce a warm scent. Spicy plants include *Chrysanthemum*, *Florists' broom* (*Genista*), *Hypericum*, *Pink Dianthus* and *Stock*. Some plants aid in undesirable scent removal. Plants such as *Ficus*, *Spider plant* and *Peacy Lily* can filter out pollutants and leave the air fresh and clean. Plants can also remove chemicals from the air, such as those in paints, new carpets and furniture. A number of natural plant extracts are used for scent in beauty and cosmetic products. The most common medicinal plants are: *Eucalyptus*, *Aloe Vera* and *Chamomile*.²⁵⁻³⁴

The time of year is an important consideration when planning a scent garden. Some plants produce fragrance all year, such as evergreen. Planting and choosing scent-

ed plants for different seasons will assure a good balance. In order to have scent in garden twelve months of the year just like color, fragrance can be produced in different flowers.

Many of phytochemical constituents of medicinal plants demonstrate inhibition of tissue and bacterial hyaluronidase.³⁵ There is growing interest in use of complementary and alternative medicine among adult patients attending the ear, nose, and throat.³⁶ Echinacoside is a caffeoyl conjugate of *Echinacea* with known anti-hyaluronidase properties. Wound healing effects of *Echinacea* on vocal fold and functional voice outcomes have been investigated.³⁷ Histologically, treated vocal folds revealed stable hyaluronan content and no significant accumulation of collagen compared with controls. Findings provide a favorable outcome of anti-hyaluronidase treatment on acute vocal fold wound healing and functional measures of voice.³⁵ Chicoric acid (*Dicaffeoyl-tartaric acid*), is a natural phenolic compound found in a number of plants, such as chicory (*Cichorium intybus*) and *Echinacea* (*Echinacea purpurea*), which possesses antioxidant, anti-inflammatory, antiviral, and analgesic activities. Results suggest that chicoric acid has an anti-allergic-related anti-inflammatory effect that involves modulating mast cell-mediated allergic responses. Therefore, chicoric acid could be an efficacious agent for allergy-related inflammatory disorders.³⁶ Herbal medicines are used worldwide by practitioners of traditional medicine to treat sore throat.³⁷ Based on research

done by Shi and coworkers, some Chinese herbal medicines for treating sore throat appeared efficacious. However, there is the lack of high quality results in clinical trials.³⁸⁻⁴⁰

Conclusion

Due to the beneficial impact of medicinal plants in medicine there is a growing interest in analytical identification and quantification for clinical medicine and forensic toxicology.

Acknowledgements

Dorota Bartusik-Aebischer acknowledges support from the National Center of Science NCN (New drug delivery systems-MRI study, Grant OPUS-13 number 2017/25/B/ST4/02481).

References

- Nogueira JF Jr, Hermann DR, Américo RdosR, Filho ISB, Stamm AE, Pignatari SS. A brief history of otorhinolaryngology: otology, laryngology and rhinology. *Braz J Otorhinolaryngol.* 2007; 73(5):693-703.
- Shakeel M, Trinidad A, Ah-See KW. Complementary and alternative medicine use by otolaryngology patients: a paradigm for practitioners in all surgical specialties. *Europ Arch Otorhinolaryngol.* 2010; 267(6):961-971.
- Shakeel M, Trinidad A, Ah-See KW. Complementary and alternative medicine use by otolaryngology patients: a paradigm for practitioners in all surgical specialties. *Europ Arch Otorhinolaryngol.* 2010; 267(6):961-971.
- Brackmann D, Shelton C, Arriaga MA. *Otologic Surgery.* Elsevier; 2016. ISBN: 978-0-323-299775. -9.
- Karaman E, Yilmaz M, Ibrahimov M, Hacıyev Y, Enver O. Malignant otitis externa. *J Craniofac Surg.* 2012; 23(6):1748-1751.
- Lasmar A, Seligman, J. *História (e histórias) da Otologia no Brasil, Revinter.* Solvay Farma; 2014. ISBN 85-7309-801-5.
- Hawkins JE. Sketches of Otohistory: part 5 - Prosper Ménière: Physician, Botanist, Classicist, Diarist and Historian. *Audiol Neurotol.* 2005; 10:1-5.
- Chauhan DS, Guruprasad Y. Auricular Reconstruction of Congenital Microtia Using Autogenous Costal Cartilage: Report of 27 Cases. *J Maxillofac Oral Surg.* 2012; 11(1): 47-52.
- Møller AAGER. The Acoustic Middle Ear Muscle Reflex. Handbook of Sensory Physiology. *Springer Auditory Syst.* 1974; 5(1):519-548.
- Jewett DL, Romano MN, Williston JS. Human auditory evoked potentials: possible brain stem components detected on the scalp. *Science.* 1970; 167(3924):1517-1518.
- Vaughan CW. Transoral laryngeal surgery using the CO₂ laser: laboratory experiments and clinical experience. *Laryngoscope.* 1978; 88(9 Pt 1):1399-1420.
- Harris AT, Tanyi A, Hart RD, et al. Transoral laser surgery for laryngeal carcinoma: has Steiner achieved a genuine paradigm shift in oncological surgery? *Ann R Coll Surg Engl.* 2018; 100(1):2-5.
- Macchiarini P, Jungebluth P, Go T, et al. Clinical transplantation of a tissue-engineered airway. *Lancet.* 2008; 372(9655):2023-2030.
- Tülin KF, Hakan KK, Altıntaş A, Firat P, Sayin I. First successful transoral robotic resection of a laryngeal paraganglioma. *J Otolaryngol Head Neck Surg.* 2012; 41(6):E54-57.
- Weir N. History of Medicine: Otorhinolaryngology. *Postgrad Med J.* 2000; 76:65-69.
- Boyle WS, Smith GE. Charge coupled semiconductor devices. *Bell Syst Tech J.* 1970; 49:587-593.
- Tahir A. The Evolution of Laser in Laryngology. *Intern. J Otolaryngol Head Neck Surg.* 2015; 4:137-140.
- Shikani AH, Domb AJ. Polymer chemotherapy for head and neck cancer. *Laryngoscope.* 2000; 110(6):907-917.
- Hamdan AL, Haddad G, Haydar A, Hamade R. The 3D Printing of the paralyzed vocal fold: added value in injection laryngoplasty. *J Voice.* 2017; 0892-1997(17)30269-2.
- Lascaratos JG, Segas JV, Trompoukis CC, Assimakopoulos DA. From the roots of rhinology: the reconstruction of nasal injuries by Hippocrates. *Ann Otol Rhinol Laryngol.* 2003; 112(2):159-162.
- Feldmann H. The maxillary sinus and its illness in the history of rhinology. Images from the history of otorhinolaryngology, highlighted by instruments from the collection of the German Medical History Museum in Ingolstadt. *Laryngorhinootologie.* 1998;77(10):587-595.
- Tange RA. Some historical aspects of the surgical treatment of the infected maxillary sinus. *Rhinology.* 1991; 29(2):155-162.
- Kubo S, Kikawada T, Hasegawa H, Tominaga S, Yoshimine T. Irrigation-suction straw sheath system for a rigid endoscope during endonasal endoscopic pituitary surgery. *Minim Invasive Neurosurg.* 2005; 48(6):373-375.
- Gitter AH. A short history of hearing research. I. Antiquity. *Laryngorhinootologie.* 1990; 69(8):442-445.
- Schwermer M, Längler A, Fetz K, Ostermann T, Zuzak TJ. Anthroposophic medicine in the treatment of pediatric pseudocroup: A systematic review. *Complement Ther Med.* 2018;40:185-19
- Malcolm BJ, Tallian K. Essential oil of lavender in anxiety disorders: Ready for prime time? *Ment Health Clin.* 2018;7(4):147-155.
- Henley-Smith CJ, Botha FS, Hussein AA, Nkomo M, Meyer D, Lall N. Biological Activities of *Heteropyxis natalensis* Against Micro-Organisms Involved in Oral Infections. *Front Pharmacol.* 2018;9:291.
- Saleh AM, Selim S, Jaouni SA, Abdelgawad H. CO₂ enrichment can enhance the nutritional and health benefits of parsley (*Petroselinum crispum* L.) and dill (*Anethum graveolens* L.). *Food Chem.* 2018;269:519-526.
- Mohammed FA, Elkady AI, Syed FQ, Mirza MB, Hakeem KR, Alkarim S. *Anethum graveolens* (dill) - A medicinal

- herb induces apoptosis and cell cycle arrest in HepG2 cell line. *J Ethnopharmacol*. 2018;219:15-22.
30. Osanloo M, Sereshti H, Sedaghat MM, Amani A. Nano-emulsion of Dill essential oil as a green and potent larvicide against *Anopheles stephensi*. *Environ Sci Pollut Res Int*. 2018;25(7):6466-6473.
 31. Kamari A, Sepahvand A, Mohammadi R. Isolation and molecular characterization of *Cryptococcus* species isolated from pigeon nests and Eucalyptus trees. *Curr Med Mycol*. 2017;3(2):20-25.
 32. Lapid D, Qureshi MA, Quresh IA, Afzal MR, Maud A, Rodriguez GJ, Khatri R. Possible Reversible Cerebral Vasoconstriction Syndrome Associated with Eucalyptus: *Case Report J Vasc Interv Neurol*. 2017;9(5):17-20.
 33. Li Y, Xu YL, Lai YN, Liao SH, Liu N, Xu PP. Intranasal co-administration of 1,8-cineole with influenza vaccine provide cross-protection against influenza virus infection. *Phytomedicine*. 2017;34:127-135.
 34. Dhakad AK, Pandey VV, Beg S, Rawat JM, Singh A. Biological, medicinal and toxicological significance of Eucalyptus leaf essential oil: a review. *J Sci Food Agric*. 2018;98(3):833-848.
 35. Rousseau B, Tateya I, Lim X, Munoz-del-Rio A, Bless DM. Investigation of anti-hyaluronidase treatment on vocal fold wound healing. *J Voice*. 2006; 20(3):443-451.
 36. Shakeel M, Little SA, Bruce J, Ah-See KW. Use of complementary and alternative medicine in pediatric otolaryngology patients attending a tertiary hospital in the UK. *Int J Ped Otorhinol*. 2007; 71(11):1725-1730.
 37. Lee GS, Cho JH, Park CS, Jung SH, Lee DH, Jun BC, Song CE, Cho KJ. The effect of Ginkgo biloba on the expression of intermediate-early antigen (c-fos) in the experimentally induced anosmic mouse. *Auris Nasus Larynx*. 2009;36(3):287-291.
 38. Shi Y, Gu R, Liu C, Ni J, Wu T. Chinese medicinal herbs for sore throat. *Cochrane Database Syst Rev*. 2007; (3):CD004877.
 39. Hoseinifar SH, Sun YZ, Wang A, Zhou Z. Probiotics as Means of Diseases Control in Aquaculture, a Review of Current Knowledge and Future Perspectives. *Front Microbiol*. 2018;9:2429.
 40. Wei F, Liao XF, Liu XF, Yang MH, Lu JH, Kong WJ. Research progress of pretreatment technology for mycotoxin detection in Chinese materia medica and complex matrices. *Zhongguo Zhong Yao Za Zhi*. 2018 ;43(17):3431-3443.