GINGER SPECIES AND THEIR TRADITIONAL USES IN MODERN APPLICATIONS

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RINGKASAN: Halia kerap digunakan dalam perubatan tradisional dan masakan. Terdapat pelbagai spesies dan varian halia di Malaysia dan negara iklim tropika di Asia, sama ada ia ditanam secara komersial atau tumbuh liar dan masih diekploitasi. Penemuan saintifik membuktikan bahawa bahan aktif daripada beberapa spesies halia mempunyai aktiviti biologi dan perubatan seperti anti-tumor, antioksidan, anti-radang dan sebagainya. Oleh itu, nilai-nilai perubatan halia perlu dieksplotasi untuk aplikasi rawatan moden contohnya dalam perubatan, makanan kesihatan dan kosmetik, seiring dengan permintaan tinggi terhadap produk semulajadi yang selamat, mudah diperolehi, berkesan dan murah. Untuk menghasilkan produk berkualiti, faktor proses huluan dan hiliran halia perlu diambilkira seperti bekalan bahan mentah yang mampan, pemiawaian dan kawalan kualiti, proses pengekstrakan yang efektif, kestabilan produk dan keberkesanan ekstrak.

Abstract

Ginger is traditionally known for its medicinal and culinary value. There are various species and variant of ginger in Malaysia and other tropical Asian countries, some are grown commercially, while some are still left unexplored. Scientific evidences have proven that active phytochemicals of gingers possess numerous biological and medicinal properties such as anti-tumor, antioxidant, anti-inflammatory and many others. There is a need to exploit the medicinal properties of gingers for modern application such as in medicine, supplement and cosmetics, aligned with consumer demands for safe, natural, and sustainable, effective and economical product. In order to produce high-valued product, several aspects of upstream and downstream processes of gingers should be considered such as sustainability of supply chain, standardization and quality control, efficient extraction processes, stability and proven efficacy of the extracts.

Keyword:

Zingiberaceae, traditional medicine, cosmetics, biological activities, extracts, phytochemicals

INTRODUCTION

The family *Zingiberaceae* are readily differentiated from other families in the order Zingiberales by its aromatic property and is the most diverse in terms of its utilization. The pantropical *Zingiberaceae* is the largest family in the order Zingiberales with 53 genera and over 1200 species (John Kress *et al*., 2002). Zingiberales currently has within it, eight families of which, the *Zingiberaceae* or ginger family is one of the largest families and is predominantly found in tropical Asia. Of the approximately 1200 species of plants found in the Ginger family, about 1000 occur in tropical Asia.

Zingiberaceae have been reported to be useful as food, traditional medicine, spice, condiment, dye and flavour. These are perennial aromatic herbs which form part of the undergrowth flora of tropical and sub-tropical forests with orchid like flowers. More than 150 wild and cultivated zingiberaceous species have been reported for Peninsular Malaysia and 40-50 species have been widely utilized for various purposes (Larsen *et al*.,1999).

Rhizomes of ginger plants have been widely used as spices or condiments (Larsen *et al*.,1999). Rhizomes are eaten raw or cooked as vegetables and used for flavouring food. Major commercially cultivated species are *Zingiber officinale*, *Curcuma longa*, and *Alpinia galanga*. As traditional medicine, rhizomes of ginger plants are consumed by women during ailment, illness and confinement. Rhizomes are also taken as carminatives for relieving flatulence. Leaves of ginger plants have also been used for food flavouring and in traditional medicine.

TRADITIONAL USE OF GINGERS

Many species of gingers have been reported to be used traditionally as herbal medicines and general wellness. In Okinawa, Japan, leaves of *Alpinia zerumbet* are sold as herbal tea, and are commonly used to flavour noodles and to wrap rice cakes. The hypotensive, diuretic, and anti-ulcerogenic properties of tea from *A. zerumbet* leaves have been reported (Mpalantinos *et al*.,1998).

In Peninsular Malaysia, boiled leaves of *Hedychium* species are eaten for indigestion (Ibrahim *et al*.,2001). Leaves are sometimes eaten with betel nut to ease abdominal pain. In Thailand, boiled leaves of *Hedychium coronarium* are applied to relieve stiff and sore joints. Traditionally, leaves of *Elettariopsis latiflora* have been used to relieve flatulence, to improve appetite and as an antidote to poisons (Lim *et al*., 2003)

Lengkuas (*Alpinia galanga* also called greater galangal) is also one of the most widely used herbals, especially in culinary in Asian continent and more specifically in south and southeast Asia. Similar to ginger, the rhizomes of lengkuas also finds its applications in traditional medicine (Yang *et al*., 1999), and several bioactive compounds are reported from it (Janssen *et al*., 1985; Itokawa *et al*., 1987; Kondo *et al*., 1993; Zheng *et al*.,1993)

Zingiber officinale or the common gingeris one of thetraditional folk medicinal plants that have been used for over 2000 years by Polynesians for treating diabetes, high blood pressure, cancer, fitness and many other illnesses (Tepe *et al*., 2006).

Zingiber montanum Koenig syn. *Zingiber cassumunar* Roxb. is native to India. It is known as bonglai in Peninsular Malaysia, bangle in Java and plai in Thailand. This plant is highly valued for its medicinal properties. *Zingiber cassumunar* Roxb. synonyms, *Zingiber purpureum* Rosc., *Zingiber cliffordiae*, *Zingiber montanum* (J. König) Theilade is used in folk medicine for the treatment of conditions such as inflammation, sprains, rheumatism, muscular pain, wounds and asthma, and as a mosquito repellant, a carminative, a mild laxative and an antidysenteric agent, cough and used as a cleansing solution for skin diseases (Oliveros *et al*.,1996). In Malaysia, the rhizome is used for post-natal treatment, swelling and rheumatism. In Thailand they are applied for joint pain, intestinal disorders and numb feet (Sirirugsa, 1998).

Torch ginger (*Etlingera elatior*), which is locally known in Malaysia as “kantan” is a species native to Sumatera, Indonesia and widely cultivated throughout the tropics. In Peninsular Malaysia, the plant is cultivated for its young flower shoots, which can be eaten raw and used to flavor local dishes (Abdelmageed *et al*., 2011). Torch ginger (*Etlingera elatior*) is a popular

plant in South-East Asia wherein their inflorescences are traditionally used for culinary and medicinal purposes.

Boesenbergia rotunda (L.) Mansf. Kulturpfl. (syn. *Boesenbergia pandurata* (Robx.) Schltr.), locally known inThailand as kra-chai, is a perennial herb belonging to the Zingiberaceae family. It is also known as ‘temu kunci’ in Malaysia. *Boesenbergia rotunda* is the most abundant *Boesenbergia* species in Malaysia. . It is commonly used in Southeast Asia as a food ingredient, a folk medicine for the treatment of several diseases such as aphthous ulcer, dry mouth, stomach discomfort, leucorrhea and dysentery. The rhizomes are given as tonics, to women in mixtures after childbirth; added into lotions for rheumatism and muscular pains, and into pastes for application to the body after confinement (Burkill, 1935).

The *Zingiberaceae* plant, *Alpinia conchigera* Griff. is a herbaceous perennial, 2.5 feet tall, widely cultivated in China, India and Southeast Asian countries such as Thailand, Indonesia, and Malaysia. In Malaysia, it is known locally as 'lengkuas ranting', 'lengkuas kecil', 'lengkuas padang', 'lengkuas getting' or 'chengkenam' (Janssen *et al*., 1985; Burkill, 1966). The rhizome of *Alpinia conchigera* has been extensively used as a spice for flavoring food, as well as in Thai traditional medicine for the treatment of various diseases such as skin disease, venereal disease, and bronchitis, or as an appetizer, digestive stimulant, analgesic and anti-inflammatory treatment in Vietnam (Vo, *et al*.,1997). This plant has also been reported to have gastroprotective effects (Yutana *et al*., 2008). It has been used as a condiment in the northern states of Peninsular Malaysia and occasionally in traditional medicine to treat fungal infections. (Ichikawa *et al*., 2005) This plant has been well studied for its potential to treat human breast carcinoma cells (Campbell *et al*., 2007), human T cell lymphoma (Ichikawa *et al*., 2005) and in the inhibition of tumor promoter-induced Epstein-Barr virus Kondo *et al*., 1993.

Z. zerumbet, commonly known as the pineconeor shampoo ginger, is a perennial, tuberous root herb plant that can be found growing naturally in damp, shaded partsof the lowland or hill slopes, as scattered plants or thickets. It is known by various names, for example, “*Lempoyang*” (Malaysia and Indonesia), “*Ghatian*” and “*Yaiimu*” (India),“*Jangli adha*” (Bangladesh), “*Awapuhi*” (Hawaii), “*Zurunbah*”(Arab), “*Hong qiu jiang*” (China), and “*Haeo dam*” or“*Hiao*

dam" (Northern Thailand) (Huang *et al*., 2005; Bhuiyan *et al*.,2009; Zakaria *et al*.,2010;Tushar *et al*., 2010).

This herbal plant isbelieved to be native to India and the Malaysian Peninsula,and since it has been cultivated for so long in so manyplaces throughout Southeast Asia, the Pacific, and Oceania,it became uncertain as to where the plant had originated. *Z.zerumbet* has also been claimed to be introduced throughout the Pacific by the ancient Polynesian settlers (Vimala *et al*.,1999).

Some of the traditional usages of *Zingiber Zerumbet* as botanical medicine include the treatment of inflammation, fever, toothache, indigestion, constipation, diarrhea, severe sprains, and to relieve pain, as well as antispasmodic, antirheumatic, and diuretic agents (Bhuiyan *et al*.,2009; Zakaria *et al*.,2010 Sulaiman *et al*.,2010; W. Wutthithamavet *et al*.,1997)

SCIENTIFIC EVIDENCE AND STUDIES CONDUCTED ON GINGER SPECIES

Several studies have revealed that the members of the *Zingiberaceae* family consist of a wide variety of active phytochemicals and possess antioxidative, anti-inflammatory, anticancer and anti-tumour promoting activity (Ling *et al*., 2005). *Zingiber officinale* contains a number of antioxidants such as beta-carotene, ascorbic acid, terpenoids, alkaloids, and polyphenols such as flavonoids, flavones glycosides, rutin, *etc*. (Bartley *et al*., 2000). Easily cultivable, *Zingiber officinale* with its wide range of antioxidants can be a major source of natural or phytochemical antioxidants (Stoilova *et al*., 2007). Although various extracts are obtained from ginger, it is the CO_2 extracts that are richest in polyphenol compounds and have a composition that closely resembles that of the rhizomes (Shati *et al*., 2009). Total flavonoids and some flavonoid components including quercetin, rutin, catechin, epicatechin, kaempferol and naringenin were extracted from the leaves and rhizomes of two varieties of *Zingiber officinale* planted in Malaysia (Halia Bentong and Halia Bara) (Ali *et al*., 2010). Results suggested a good flavonoid content and antioxidant activity potential in ginger leaves at 8 weeks after planting. The leaves of these ginger varieties could be useful for both food flavourings and in traditional medicine.

Zingiber officinale has been reported as detoxifying agent against alcohol abuse (Shati *et al.*, 2009) and bromobenzene intoxication (El-Sharaky *et al*., 2009; Matsuda *et al*., 2009 and Habib *et al*., 2008) and it has been studied for its antidiabetic, anti-hyperlipidimic and hepatic anticancer effect. *Zingiber officinale* acts as a nutraceutical agent against liver fibrosis as reported by Motawi *et al*., 2011. The common ginger has been listed in "Generally Recognized as Safe" (GRAS) document of the US FDA, where a dose of 0.5-1.0 g of ginger powder ingested 2-3 times for periods ranging from 3 months to 2.5 years did not cause any adverse effects (Langner *et al*., 1998).

Zingiber montanum were reported to have anti-fungal, anti-inflammatory, analgesic and anti-oxidant activity. This probably is due to the presence of certain secondary metabolites such as zerumbone, curcuminoid and (E)-1-(3,4-dimethoxyphenyl)but-1-ene (Kishore *et al*., 1992; Ozaki *et al*., 1991; Habshah *et al*., 2000)

Z. cassumunar essential oil was found to exhibit absolute fungitoxic activity (Tripathi *et al.*, 2008). A number of pure compounds isolated from the plants have been shown to possess anti microbial activity (Habshah *et al*., 2000, Giwanon *et al*., 2000) topical and oral anti-inflammatory (Jitoe *et al*.,1994; Pongprayoon *et al*.,1997) antioxidative activity (Habshah *et al*., 2000; Jitoe *et al*.,1994; Pongprayoon *et al*.,1997) and antihistaminic effect (Piromrat *et al*., 1986) as well as activity as a smooth-muscle relaxant (Kanjanapothi *et al*., 1987) rhizome oil of *Z. cassumunar* Roxb. from Malaysia was found to exhibit high activity against yeasts (Bin *et al*., 2003)

As regards to its biological activities, *Boesenbergia rotunda* exhibits antimutagenic, antitumour, antibacterial, antifungal, analgesic, antipyretic, antispasmodic, anti-inflammatory and insecticidal activities (Cheenpracha *et al*., 2005). Previous investigations have revealed the isolation of pinostrobin , pinocembrin , cardamonin , alpinetin and Boesenbergin A from the rhizomes of *Boesenbergia rotunda* (Jaipetch *et al*., 1982; Mongkolsuk *et al.*, 1964), in which 2-D NMR technique was used for the structure elucidation of Boesenbergin A to complement the data reported previously (Cheenpracha *et al*., 2005 Mahidol *et al*., 1984).

Reports available have shown torch ginger, *Etlingera elatior* to exhibit rich antioxidant, anticancer and antimicrobial activities. (Chan *et al*., 2007; Chan *et al*., 2008; Habsah *et al*., 2005). Chan *et al*. 2007 reported that, of 26 ginger species, *Etlingera* species had the highest phenolic content and radical activity compared to other *Zingiberaceae* species and further stated that the leaves of *E. elatior* had the most outstanding antioxidant properties among five *Etlingera* species investigated. The inflorescence of torch ginger (*Etlingera elatior* Jack) was analyzed toidentify its nutritional and anti-nutritional contents (Jeevani *et al*., 2011). The presence of significant amount of protein, fiber, and fatty acids and minerals confirm the usefulness of torch ginger inflorescence as a potential functional food and could be further explored in new food products and formulations.

Rhizomes of gingers have been reported to have tyrosinase inhibition properties (Chan *et al*., 2008). The depigmentation activity of extracts of *Curcuma xanthorrhiza* and *Zingiber zerumbet* have been reported (Zanariah *et al*., 2005). Skin-lightening cosmeceutical products were recently developed from rhizomes of gingers from the species *Curcuma xanthorrhiza* and *Zingiber zerumbet* (Rozanida *et al*., 2005)

The anti-inflammatory profile of intraperitoneally administered aqueous of *Zingiber zerumbet* and ethanol extract of *Zingiber zerumbet* at the doses of 25–100 mg/kg, against prostaglandin-E2-(PGE2-) induced paw edema test has been reported earlier by Somchit and Nur Shukriyah (Nhareet *et al*., 2003). The methanolic extract of *Zingiber zerumbet*, was shown to inhibit platelet-activating factor (PAF) receptor-binding effects using rabbit platelets (Jantan *et al*., 2005).

GINGER SPECIES FOR COSMETIC APPLICATIONS

The cosmetics industry is, probably, one of the most profitable industries worldwide. There is a trend in the cosmetics industry to produce new products having also certain medicinal effects. Another common trend is the use of natural ingredients as raw materials instead of synthetic

components. Among consumers, there is a marked preference for natural products, resulting in the present good market positioning of products containing natural ingredients.

Medicinal plants are widely used as bioactive raw materials for cosmetics and personal care products. The source of medicinal plants varies greatly, from wild crafting traditional medicinal plants in China to modern horticultural production systems in North America and Europe. Although some growers make their own extracts, others use contract manufacturers that can be found throughout the world. Issues affecting the sourcing and use of gingers for cosmetics and personal care products such as sustainability, economics, reproducibility and quality control should be addressed by the industry (Barbara, 2012).

The Malagasy ginger showed a unique and characteristic organoleptic and chemical profile which makes them ideal for cosmetic applications. Because of these properties, the company Chanel, has selected the Malagasy ginger and their extractives for use as ingredients for their line of perfumes (Fabien *et al*., 2009).

In Malaysia, extracts from the rhizomes of *Zingiber Zerumbet* and *Curcuma xanthorhiza* have been commercially used in skin lightening products (Ujang *et al.,* 2005, Abdul Rahman *et al.,* 2005). Both the Xanzwhite and NLC Phyto Serum products have been developed by SIRIM Berhad and marketed by the company Sireh Emas marketing Sdn. Bhd. The aqueous and supercritical fluid extracts have been shown to possess good anti tyrosinase activity and inhibit melanin synthesis *in vitro*.

The shell ginger plant (Alpinia Zerumbet) is native to the islands of Okinawa, Japan. The leaves are extremely rich in polyphenol (30 times more than red wine) and traditionally used to brew a healthy, soothing tea. Recently, scientists discovered that these leaves are also highly effective in stimulating collagen synthesis. Kanebo Cosmetics is using the extract in their anti-wrinkle cosmetics (http://www.kanebo.com/science/orientalherbs.html).

Symrise, a global supplier of fragrances, flavorings, cosmetic active ingredients and raw materials as well as functional ingredients launches SymVital® AR, which is a 100 % pure and natural ginger root extract. SymVital® AR is proven to significantly improve the skin texture and smoothness of stressed skin, smoothing wrinkles and enhancing complexion regularity in

three weeks. It also helps to reduce signs of sun damages in less than two weeks (http://www.symrise.com/newsroom/article/universal-and-versatile-skin-beautifier-for-all-ages-from-ginger-rootbrsymrise-launches-symvitals).

Another company, Sederma has developed a new active from *Zingiber zerumbet* extract obtained through supercritical CO_2 fluid extraction that helps to alleviate discomfort and premature aging of the leg. The active is said to inhibit the inflammatory phenomena leading to lipid storage and water retention to improve circulation in the legs and relieve the sensation of tiredness. (http://www.cosmeticsdesign-europe.com/Formulation-Science/Sederma-develops-ginger-extract-for-ageing-legs).

ISSUES ON THE CURRENT APPLICATION OF GINGERS

Due to the immense demand for gingers, rhizomes as well as whole plants are being collected from the wild in huge quantities. This indiscriminate collection of rhizomes coupled with vanishing forests and grasslands resulted in the depleting of gingers in the wild. Unless some strong conservation measures are taken, many members will move to extinct category in the near future.

Since there is a need to exploit the medicinal properties of gingers, therefore more planting material is needed. Slow propagation rate and the risk of disease transmittance through division by sectioning of the rhizomes have hampered propagation by conventional means.

Thus *in vitro* technique is considered the best alternative that can supply a large number of planting materials for commercial planting. *In vitro* technique is a useful approach for propagating plants on large scale. For ginger species, propagation through conventional technique is time consuming and the risk of disease transmittance is there.

The ginger species have been reported to possess many interesting biological properties which present good potential for cosmetics and pharmaceutical applications. Supercritical fluid extraction technology offers an environmentally friendly process of extracting phytochemicals

from ginger species, free from the hazardous constraints of using solvents for extraction. Advances in the use of use of extracts and phytochemicals from ginger species will require the efforts to address the issues such as sustainability of supply chain, standardization and quality control, efficient extraction processes, stability and proven efficacy of the extracts among other things.

Regardless of the source material or extraction process, quality control issues like contamination, reproducibility, standardization, toxicity, and protection of actives must be addressed. Additionally, sustainability of the supply chain is an important issue, not only to assure a continuous supply of raw material, but to ensure the supply chain is not harming the environment or society.

CONCLUSION

It is anticipated that in the future, the ginger species will continue to become the treasure trove of useful phytochemicals and extracts for use in the cosmetics and pharmaceutical industry. Innovation in the area of gingers for use in cosmetic products is largely consumer-driven. Today's consumer demands products that are safe, natural, and sustainable but still effective and economical.

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