Pyrex Journal of Plant and Agricultural Research

Vol 2 (2) pp. 44-53 September, 2016

http://www.pyrexjournals.org/pjpar

Full Length Research Paper

Arctium Lappa L. (Asteraceae); a New Invasive Highly Specific Medicinal Plant Growing in Egypt

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Accepted: 1st September; 2016

Abstract

This paper describes the botanical features of *Arctium lappa* L. (burdock, Asteraceae), its wide diversity of chemical constituents, its use in traditional medicine as remedies for numerous health problems and its biological activities. The plant has been used traditionally as anticancer, antimicrobial and antiviral, antiallergic, antidiabetic, anti-inflammatory, antipyretic, antioxidant, cardiovascular, cytotoxic, bronchorelaxant, hepatoprotective, hypoglycemic, hypolipidemic and a detoxifying agent. Phytochemical screening for leaves and fruits of the study species has shown that it is rich in phenolic, organic acids, and volatile compounds. Reports on the biological activities of the species are mainly on its crude extracts which have been proven to possess many biological activities. The present review will designed to highlight the botanical description, distribution, chemical constituents and the pharmacological effects of *A. lappa*. Thus, studies related to identification of the bioactive compounds and correlating them to their biological activities are very useful for further research to explore the potential of *A. lappa* as a source of therapeutic agents.

Keywords: *Arctium lappa*, Distribution, Botanical description, Active constituents, Pharmacological effects.

INTRODUCTION

The use of phytomedicine and phytonutrients or nutraceuticals continues to expand quickly across the world with many people now resorting to these products for treatment of numerous health challenges in different national healthcare settings (WHO, 2004). Although modern medicine may be available in the developing countries, current assessments suggested that a large proportion of the population relies heavily on traditional practitioners and medicinal plants to meet primary health care needs (Rotblatt and Ziment, 2002). In most countries the herbal medicine markets are poorly regulated, and herbal products are often neither registered nor controlled.

Assurance of the safety, quality, and efficacy of medicinal plants and herbal products has now become a key issue in industrialized and in developing countries. Both the general consumer and healthcare professionals need up-to-date, authoritative information on the safety and efficacy of medicinal plants (WHO, 1999).

The name of *A. lappa* is derived from the Greek, arktos or “bear” and lappa “to seize (Ody, 1993) commonly known as burdock and is being recommended as a healthy and nutritive food in Chinese societies and many other countries (Chan *et al*., 2011). *A. lappa* is widely used in popular medicine all over the world (Pereira *et al*., 2005). The plant has long been cultivated as a vegetable for dietary use and is also used as a folk medicine for several specific diseases and ailments (Lin *et al.,* 2002). Several studies have reported that the plant possesses various pharmaceutical activities including an antibacterial activity, antifungal activity (Pereira *et al*., 2005), antiplatelet- aggregating effect (Lin *et al.,* 2002), antioxidant (Chen *et al*., 2004; Leonard *et al.,* 2006), hepatoprotective efficacy (Lin *et al.,* 2000) and anti-inflammatory activity (Lin *et al*., 1996; Chen *et al.,* 2004). Pereira *et al*. (2005) have demonstrated that *A. lappa* exhibits antimicrobial activity against oral microorganisms

(A) (B) (C) (D)

Plate 1: Description of *Arctium lappa* L. (**A:** whole plant; **B:** leaf; **C:** Inflorescence; **D:** Flower) (Photos taken by the authors).

and those components also have des-mutagenic effects (Morita *et al.,* 1995). The roots are widely used in food, whereas the seeds are used in traditional medicine as diuretic, antipyretic, or detoxifying agents (Park *et al*., 2007). In recent years, the crude water extract of *A. lappa* (herbal tea) has become a promising and important beverage, because it has ample therapeutic action (Lin *et al.,* 2002). It has been pointed out by various researchers that the extensive use of herbal medicines is not as safe, as is often claimed to be, and this medicinal plant may not be an exception. It can be detrimental to take herbal medicines without being aware of their potential adverse effects (Capasso *et al.,* 2000).

In order to establish the therapeutic efficiency of these plants, scientific studies are essential. The species is considered as an invasive annual weed of high nitrogen soil. It is introduced and naturalized in Egypt in crop fields and gardens, especially at Burg El-Arab (50 Km south of Alexandria and Nubaria region (60-70 km south of Alexandria) and show appearance of woody tissues to modify and considered as a perennate biennial herb (personal communication). The species needs further comprehensive studies to explore species potentiality in the field of new drug discovery. The present study describes the botanical features of *A. lappa*, its distribution, as well as its pharmacological effects.

Medicinal Species within Genus *Arctium*

Two common species within genus *Arctium* are known; *Arctium lappa* and *Arctium minus* (Peirce, 1999).

Plant Description

Taxonomically, *A. lappa* belongs to family Asteraceae which considered one of the largest families of flowering plants with about 1100 currently accepted genera and 2500 species (Heywood, 1997). The plant is a biennial herb reaching as much as 2 m. The stem has multiple branches, each of which is topped by many crimson-violet flower heads that produce the famous “burrs” that give burdock its name (Kathi and Mitchell, 1999). The plant has large, alternating, cordiform leaves that have a long petiole and are pubescent on the underside. The lower leaves are very large, on long, solid foot-stalks, furrowed above, frequently more than a foot long heart-shaped and of a grey color on their under surfaces of the mass of fine down with which they are covered. The upper leaves are much smaller, more egg-shaped in form and not so densely clothed beneath with the grey down. The flowers are purple and grouped in globular capitula, united in clusters. They appear in midsummer, from July to September. The capitula are surrounded by involucres made out of many bracts, each curving to form a hook, allowing them to be carried long distances on the fur of animals. The fruits are achenes; they are long, compressed, with short pappuses (Plate 1). The fleshy taproot can grow up to 1 m long (Ghahreman, 2009). The deep roots are brownish-green, or nearly black on the outside (Zhao *et al.*, 2009). However, Chan *et al*. (2011) reported that *A. lappa* is considered as an invasive weed growing in high nitrogen soil. It is a biennial or perennial herb stores most of its nutrients during the first year. These nutrients are then used for the flower-blooming process afterward.

Distribution

The study species are native to the Europe and Asia (Plate 2). It was introduced to North America by early European settlers and now grows wild across most of the United States and Canada (Mabey *et al.,* 1988) also in Japan and parts of Europe; it is cultivated as a vegetable outside (Zhao *et al.*, 2009). It is frequently grown for medicinal use in Bulgaria, Yugoslavia, Poland and Hungary, where limited quality control may increase the possibility of contamination with *Atropa belladonna* (Kathi and Mitchell, 1999).

Cultivation, Propagation and Harvesting

A. lappa has been cultivated as a vegetable for a long time in Taiwan and Japan (Morita *et al*., 1993). The plant is readily grown from seed in moist, rich soil and full sun. Roots can be harvested in the fall of the first year of growth or the spring of the second year. Seeds sow directly into the garden. He *et al*., (2006) describes a practice for plant regeneration from cultured seedling explants of *A. lappa* hypocotyls and cotyledons which were induced to form callus. The regenerated plants acclimatized in soil were normal morphologically and in

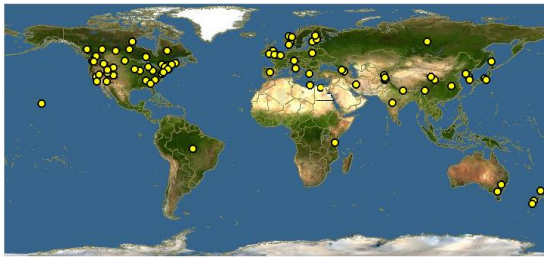

Plate 2*:* Distribution of *Arctium lappa* along the world. (http://www.discoverlife.org/mp/20m?kind=Arctium+lappa).

in growth characters. They flowered and set seed in the following year after acclimatization. Many herbalists mix wood chips and sawdust into burdock beds to keep the soil loose so roots are easier to harvest. The tops make an excellent addition to organic compost. *A. lappa* is found on sandy clay or loam (Moore and Frankton, 1974) and in moist lowland meadows (Hawthron and Hayne, 1978). The species is generally found on more fertile soils (Gross *et al*., 1980). The plant, which can be found worldwide, has been cultivated as a vegetable for a period of long time in Asia (Morita *et al*., 1993).

Ethnomedicine

A. lappa has been used for centuries to treat a host of ailments. It has been traditionally used as a "blood purifier" to clear the bloodstream of toxins, as a diuretic (helping rid the body of excess water by increasing urine output), and as a topical remedy for skin problems such as eczema, acne, and psoriasis. In addition, *A. lappa* is often used with other herbs for sore throat and colds. Extracts of plant roots are found in a variety of herbal preparations as well as homeopathic remedies. It is a cold temper plant with leaves contain Arktiopikerin (it has soothing, blood purgative, increasing respiration effects and its infusion is a good remedy for dizziness and general debility). Its seeds have antiparasitic effects (Johnson *et al.,* 1995).

A. lappa is now in use for treating cancer and upper respiratory infections and pneumonia in China. The plant was used to treat leprosy, fevers a variety of dermatologic conditions (baldness, scrapes, and burns), syphilis and gonorrhea. American herbalists used the plant as a diuretic and to treat arthritis, urinary tract problems, lice, ringworm, and eczema. Native Americans included the root in herbal preparations used by women in labor 2. Furthermore, the plant is traditionally used as a liver tonic, diaphoretic and diuretic, blood purifier, laxative, antipyretic and antimicrobial. *A. lappa* has also been incorporated into the Canadian cancer remedy (Essiac) (Kathi and Mitchell, 1999).

Active Constituents

Many health benefits of *A. lappa* have been reported due to different classes of bioactive secondary metabolites (e.g. flavonoids, lignans and phenolic compounds) (Ferracane *et al*., 2010). The principal components of *A. lappa* are represented by the caffeylquinic acids, composed of polyphenols such as chlorogenic, caffeic, isochlorogenic and other derivatives of caffeic acid. Also present are elevated quantities of inulin, measuring from 27-45%, and mucilage, for a total of about 69% carbohydrates; about 15 polyacetylenes; ten different sulphuric acetylene compounds, such as aretic acid, arctinone, arctinol, arctinal; an essential oil rich in bitter oils; costic acids; guainolides, dehydrocostus-lactone and 11, 13 dehycrodihydrocostus-lactone, the bitter principles of the drug; lignans (neoarctin, daucosterol, arctigenin, arctiin, matairesinol and lappao). Also present are sitsterol, stigmasterol and γ-guanidino-n-butyric acid **(**Umehara *et al*., 1996). Roots contain up to 50% inulin, polyacetylenes, volatile acids (acetic, proprionic, butyric, isovaleric), non-hydroxyl acids (lauric, myristic, stearic, palmitic), tannin and polyphenolic acids. Seeds have 15-30% fixed oils, a bitter glycoside (arctiin) and chlorogenic acid (Mabey *et al.,* 1988). Six compounds were isolated from the seeds of *A. lappa.* One of them is a new lignan named neoarctin B. The structure has been elucidated on the basis of spectral analysis. The other five compounds were identified as daucosterol (I), arctigenin (II), arctiin (III), matairesinol (IV) and lappaol F (V) (Wang and Yang, 1993). The major active ingredients isolated from this herb are: tannin, arctigenin, arctiin, beta-eudesmol, caffeic acid, chlorogenic acid, inulin, trachelogenin 4, sitosterol-beta-D-glucopyran-oside, lappaol and diarctigenin Apart from these compounds, the plant also contains various common nutrients. Specifically, roots also contain:

1. Sulfur-containing polyacetylenes (00.1% - 0.002%) (Washino, 1986).
2. Polysaccharides/mucilages: xyloglucan (Kato and Watanabe, 1993).
3. Dilignans and lignans: arctigenin
4. Other: organic acids (acetic, butyric, caffeic, chlorogenic, gamma-guanidino-n-butyric, isovaleric, linoleic, linolenic, myristic, oleic, palmitic, proprionic, stearic, tiglic); aldehydes; carbohydrates (up to 50% inulin); sesquiterpene lactones, phytosterols (Newall *et al.*, 1996).

Part (s) Used and Methods of Administration in Phytotherapy

Herbal preparations include: Comminuted herbal substances, powdered herbal substance, Liquid extract (1:1), extraction solvent ethanol 25% v/v, soft extract, extraction solvent water, tincture (ratio of herbal substance to extraction solvent 1:10), extraction solvent ethanol 45% v/v and tincture (ratio of herbal substance to extraction solvent 1:5), extraction solvent ethanol 25% v/v (European Medicines Agency, 2010).

The dried root from plant forms the official drug, but the leaves and fruits are also used. The roots are dug in July, and should be lifted with a beet-lifter or a deep-running plough. Leaves which are less used than the root are collected in July and left for drying. The seeds (or fruits) are collected when ripe. They are brownish-grey, wrinkled, about 1/4 inch long and 1/16 inch in diameter. They are shaken out of the head and dried by spreading them out on paper in the sun (Grieve, 1931). For administration, simmer one tablespoon of dried roots, leaves or seeds in 2 cups of water for 20 minutes. Drink up to 4 cups daily. Tea can also be used as a skin and face wash. Apply the cooled tea to the skin with a clean face cloth, and rinse in cool water. The plant is also taken as a tincture and in extracts (Mabey *et al.,* 1988). Dried fruits of *A. lappa* are one of the most popular Chinese medicines and are officially listed in the Chinese Committee of National Pharmacopoeia (2005).

The plant had been taken iat different ages as follow:

Pediatric*:* There are no known scientific reports on the pediatric use of the plant, so it should only be given to children under the supervision of your doctor.

Adult*:* Capsules: 1 - 2 g three times per day.

1. *Dried root:* steep 2 - 6 g in 150 ml (2/3 of a cup) in boiling water for 10-15 minutes and then strain and drink three times a day; may soak a cloth in the liquid and, once cooled, wrap the cloth around the affected skin area or wound (known as a poultice). Do not use on open wounds.
2. *Tincture* (1:5): 2 - 8 ml three times per day; the tincture may also be applied to a cloth and wrapped around the affected skin area or wound fluid extract (1:1): 2 - 8 ml three times a day.
3. *Tea*: (2 – 6) g steeped in 500 ml water (about 2 cups), three times per day. Topical preparations of *A. lappa* is also used for skin problems (such as eczema) and wounds **(http://www.goldenlotusherbs.com).**

PHARMACEUTICAL EFFECTS

A. lappa contains many active ingredients that have been shown to retain many therapeutic effects for the treatment of various diseases **(Chan *et al.,* 2011).**

Anti-allergic

Traditional medicines isolated from natural products often have positive effects in the prevention and healing of various immune disorders, such as allergy and atopic inflammation. The butanol fraction of *A. lappa* showed potential anti-allergic and anti-inflammatory effects by decreasing β-hexosaminidase release in mast cells and the secretion of IL-4 and IL-5 in Con A-induced T cells (Sohn *et al*., 2011). The release of β-hexosaminidase, a key biomarker of degranulation during an allergic reaction, and the production of pro-inflammatory mediators, such as tumor necrosis factor-α (TNF-α) and prostaglandin E2 (PGE2) in the cells treated with or without the *A. lappa* fruit extract was examined by Yoo *et al.* (2016).

Anti inflammatory effect

A. lappa crude extract has shown significantly decreased carrageenan-induced rat paw edema, according to the study of “Anti-inflammatory and radical scavenge effects of *A. lappa* (Lin *et al*., 1996). Inhibition of inducible nitric oxide synthase (INOS) expression and nitric oxide (NO) production, suppression of pro-inflammatory cytokine expression, inhibition of the nuclear factor-kappa B (NF-jB) pathway, activation of antioxidant enzymes and scavenging of free radicals are the vital mechanisms of plant’s anti-inflammatory action (Chan *et al*., 2011).

The extract of *A. lappa* has been shown to exhibit anti-inflammatory response by inhibiting degranulation and release of cysteinyl leukotrienes (Cys-LTs) by peripheral blood mononuclear cells (PBMCs). Cys-LTs are synthesized inflammatory mediators such as histamine and prostaglandins. The blockade of Cys-LT is regarded as inhibition of the inflammatory response. Also, the extract significantly inhibited acute mouse ear edema due to induced allergic response. Therefore, there has been evidence suggesting that the plant has significant anti-inflammatory effect (Knipping *et al*., 2008).

Lappaol F, diarctigenin and arctigenin, found in the seeds or leaves of *A. lappa* are lignans that can inhibit NO production. Nitric oxide synthase is involved in various inflammatory diseases such as rheumatoid arthritis, autoimmune disease, chronic inflammation and atherosclerosis. Therefore, inhibition of NO production by iNOS in macrophages is a potential treatment for certain inflammatory diseases (Wang *et al*., 2006). Lappaol F and diarctigenin strongly inhibit NO production in lipo-polysaccharide (LPS)-stimulated murine macrophage RAW264.7 cells with IC50 values of 9.5 and 9.6l M, respectively (Park *et al*., 2007). Further study elucidated that diarctigenin could directly target NF-jB-activating signaling cascade by direct inhibition of the DNA binding ability of NF-jB and inhibition of NF-jB-regulated INOS expression (Kim *et al*., 2008).

Arctigenin, a phenylpropanoid dibenzylbutyrolactone lignan, potently inhibits iNOS expression and NO production through suppression of NF-jB activation and inhibition of I-jBa phosphorylation and p65 nuclear translocation in LPS-activated macrophages (Cho *et al*., 2002). In addition, arctigenin strongly inhibits the expression of pro-inflammatory cytokines tumor necrosis factor-a (TNF-a) and IL-6, in LPS-stimulated RAW264.7 cells, THP-1 human monocyte-macrophage and differentiated human macrophage U937 (Cho et al., 2002; Zhao et al., 2009). Further study showed that arctigenin-induced inhibition of TNF-a production might be mediated by arctigenin’s potent inactivation of mitogen-activated protein (MAP) kinases including ERK1/2, p38 kinase and JNK through the inhibition of MAP

MAP kinase kinase (MKK) activity, leading to inactivation of activator protein-1 (AP-1) (Cho *et al*., 2004; Zhao *et al.,* 2009). On the other hand, expression of inflammation-associated cyclooxygenase 2 (COX-2) and formation of prostaglandin E2 (PGE2) are the results of increased NO production. Inhibitor of COX-2 causes a potent inflammatory effect, since the prostaglandin family is associated with the onset of inflammation. The methanolic extract of *A. lappa* has been proven to be effective in inhibiting the expression level of COX-2 mRNA. Therefore, the anti-inflammatory effect of the plant is attributed to the lowered PGE2 release (Wang *et al*., 2006).

In view of the inflammatory processes, inflammation has usually been investigated together with the pathway of free radicals. There have been many studies on the association between free radicals, oxidative stress and inflammation (Abreu *et al*., 2006; Pontiki *et al*., 2006).

Recent studies have demonstrated *A. lappa* as anti-inflammatory characteristics on carrageenan-induced rat paw edema and carbon tetrachloride (CCl4) induced hepatotoxicity. The carrageenan-induced rat paw edema assay is a widely used model for acute inflammatory testing. The plant has shown to have significant inhibition of the growth of rat paw edema in a dose-related manner, thus suggesting some significant anti-inflammatory activities of *A. lappa* (Lin *et al*., 1996).The antioxidant power of burdock extract by detecting the signal intensities of 5, 5-dimethyl-1-pyrroline-N-oxide (DMPO)–OOH in relation to superoxide dismutase (SOD) concentration. In summary, the anti-inflammatory action of the plant is attributed to its high free radical scavenging capacities and antioxidant activity (Chan *et al*, 2011).

Antidiabetic activity

Several studies have suggested that the root and fruit are possible parts with hypoglycemic effect. Sitosterol-beta-D-glucopyranoside is considered to be the most potent and efficacious substance among the large profile of active compounds found in the root of the plant. It has demonstrated potent inhibitory effects on alpha glucosidase activities. Alpha glucosidases are involved in the processing of glycoprotein and glycogenolysis. Inhibitors of glycosidase are potential therapeutic agents in treating diabetes mellitus and obesity (Mitsuo *et al*., 2005). Hypoglycemic activities, due to its elevated inulin content (up to 45%), reserve polysaccharides contained in the root which are slightly sweet and remain unabsorbed by the organism, burdock is utilized to slow the digestion of carbohydrates, to reduce the absorption of glucose and to control conditions of hyperglycemia (glucose intolerance) (Chan *et al.,* 2011). Also, the antidiabetic activity of total lignan from the fruit of the plant has been studied in a model of alloxan induced diabetes in mice and rats. It has been proven that total lignan from *A. lappa* is a safe antidiabetic agent and may help prevent diabetic complications (Xu *et al*., 2008).

Anticancer

Arctium lappa fruit has been used in traditional medicine, and it is known to exert beneficial effects, such as antioxidant, anti-inflammatory and anticancer effects. During the development of tumors, very large amounts of nutrients (oxygen and nutrients) are required to sustain the rapid proliferation of tumor cells. However, tumor cells can still survive under extreme conditions such as low oxygen and low carbohydrate availability due to their relatively high tolerance to hostile environment. Arctigenin, an active compound found in the seeds of *A. lappa*, has the ability to eradicate nutrient-deprived cancer cells (Awale *et al*., 2006).

In addition to its broad spectrum of activities on different cancer cell lines, e.g., PANC-1 and AsPC-1, arctigenin seems to exhibit a highly preferential cytotoxicity to cancer cells that are bathed in glucose-deprived conditions (Awale *et al*., 2006; Yoo *et al*., 2016). This is because arctigenin has a potent inhibitory effect on the phosphorylation of Protein Kinase B (PKB) (Guo *et al*., 2008), which is stimulated under glucose-deprived conditions. Hence, the rate of glucose formation in cancer cells is decreased, which in turn leads to cell death due to a lack of nutrients (Awale *et al*., 2006). Protection of cells from harmful substances can greatly reduce the chance of tumor formation and thus suppresses cancer cell proliferation. Flavoniod-type antioxidants and some other active polyphenol antioxidants found in the root of burdock may account for the suppressive effects on cancer metastasis (Tamayo *et al*., 2000).

It has been shown that extracts of the root protect cells from toxic substances and lower the mutations of cells. Tannin, a phenolic compound, is one of the most common active compounds found in the root of *A. lappa*. It induces macrophage responses, inhibits tumor growth and possesses immunomodulatory properties. Nevertheless, tannin is potentially toxic in nature. It may cause stomach upset and at high concentrations has some dangerous side effects such as nephro-toxicity and hepatic necrosis (Miyamoto *et al*., 1993). Therefore, the use of tannin should be carefully monitored. Extracts from *A. lappa* beside exhibited the strongest free radical scavenging activity, but also showed selective antiproliferative activity against certain human cancer cell lines (Predes *et al.,* 2011).

In case of breast cancer, Essiac, a blend of at least four herbs [burdock root (*Arctium lappa*), Indian rhubarb (*Rheum palmatum*), sheep sorrel (*Rumex acetosella*), and the inner bark of slippery elm (*Ulmus fulva*)] have shown to boost their immune systems or increase their chances of survival. Only 2 women reported minor adverse events, whereas numerous women reported beneficial effects of Essiac (Zick *et al.,* 2006).

Arctigenin (ATG) is a nature lignan product of *A. lappa* With antioxidant, anti-inflammatory and antitumor activities (Awale *et al.,* 2006 and Zhao *et al*., 2009).It has been shown that ATG inhibits the growth of various cancer cells by induction of apoptosis (Hausott *et al*., 2003; Matsumoto *et al*., 2006) or by cell cycle arrest. As lignans have been identified as phytoestrogens, however, previous studies did not report on the effects of ATG on breast cancer.

Antimicrobial and antiviral activity

It has been reported that the lyophilized extract of the leaves of *A. lappa* exhibits antimicrobial activity against oral micro-organisms and is most effective against bacteria related to endodontic pathogens such as*: Bacillus subtilis*, *Candida albicans*, *Lactobacillus acidophilus* and *Pseudomonas aeruginosa* (Pereira *et al*., 2005). Chlorogenic acid isolated from the leaves also show restraining effects on *Escherichia coli*, *Staphylococcus aureus* and *Micrococcus luteus* (Lin *et al.*, 2004). Therefore, the leaves of *A. lappa* may be useful in treating tooth/gum diseases that are related to micro-organisms in the oral cavity. It is also a potential topical remedy for skin problems such as eczema, acne and psoriasis. In addition, the polyacetylene ingredients extracted from the root of burdock also possess potent antibacterial and antifungal activities (Takasugi *et al*., 1987).

Constituents of *A. lappa* have also demonstrated antiviral activity. Phenolic constituents such as caffeic acid and chlorogenic acid possess strong inhibitory effect on her-pesvirus (HSV-1, HSV-2) and adenovirus (ADV-3, ADV-11) **(**Chiang *et al*., 2002). Arctigenin, one of the lignanoid ingredients, has demonstrated activities against human immunodeficiency virus type-1 (HIV-1) both in vivo and in vitro (Schroder *et al.*, 1990). These suggest potential uses of these promising natural compounds isolated from burdock to treat infection by these viruses, especially HIV. Phytotherapeutic agent prepared from an ethyl acetate fraction (AcOEt) extracted from Burdock has shown inhibiting the growth of all the microorganisms (Gentil and Pereira, 2006).

Antiaging and antioxidant

Phenolic content of burdock has exerted a strong activity in fighting against forming of free radicals and foreign invaders as well as antielastase and anti-collagenase in a study of 21 plants of which may contribute to the delay of aging process (Thring *et al.,* 2009). The study of Knott *et al.* (2008) showed that topical treatment with a natural *A. lappa* fruit extract significantly improves the metabolism of the dermal extracellular matrix and leads to a visible wrinkle reduction in vivo. This means that, *A. lappa* fruit extract represents a targeted means to regenerate dermal structures and, thus, offers an effective treatment option for mature skin.

Antineoplatic effects

Recently, antiproliferative and apoptotic effects of lignans from *A. lappa* were described for leukemic cells (Awale *et al*., 2006) as well as antitumor effects of arctigenin on pancreatic cancer cell lines (Matsumoto *et al.,* 2006).

Antitussive activity

A low-molecular-weight fructofuranan of the inulin-type from the roots of *A. lappa* have asserted the antitussive activity in cats was found to be equally active as some non-narcotic (Kardosová *et al.,* 2003).

Antiurolithiasic activity

According to some authors *A. lappa* has a moderate diuretic and antilithiasic activity, and it may be due to this activity that it is utilized in folk medicine for hyperuricaemia and kidney stones (Grases *et al.,* 1994).

Gastroprotective activity

Chloroform extract of the roots from *A. lappa* protects animals from gastric lesions by reducing gastric acid secretion via inhibition of gastric H+, K+ -ATPase (Dos *et al.,* 2008).

Detoxifying and hepatoprotective activity

A. lappa is one of the foremost detoxifying herbs in both Chinese and Western herbal medicine (Chevallier, 2000). Lin *et al.* (2002) have described that the hepatoprotective mechanism associated could be attributed to its antioxidative activity. The fibers contained in burdock are able to bind toxic compounds and to facilitate their elimination. With this mechanism *A. lappa* has a significant protective activity towards hepatotoxicity that has been experimentally induced using carbon tetrachloride (CCI4) (Morita *et al*., 1995). It is also important to note that for caffeylquinhic acids a powerful activity has been described toward many hepatotoxic agents. Furthermore, the plant reduces the intestinal absorption of cholesterol and lipids, but the most interesting feature is the reduced formation of lithocolic acid (LCA) from the cholic and deoxychoic acids (DCA). Since lithocolic acid is hepatotoxic, mutagenic and potentially carcinogenic, the LCA/DCA ratio in the bile and intestine is taken by some authors as an indication of risk for colorectal cancer. *A. lappa*, like other dietary fibers, reduces the level of this index thus the traditional use of the plant as a hepatoprotector, “depurative” and “detoxicant” finds confirmation in these experimental

observations (Shimizu *et al*., 1996). *A. lappa* could protect the liver cells caused by CCl4 or acetaminophen as a result of its antioxidative effect on hepatocytes, hence eliminating the deleterious effects of toxic metabolites from CCl4 or acetaminophen (Lin *et al*., 2000). Recently, Salama (2014) reported that methanolic root and leaf extracts of *A. lappa* both affects the liver positively through improving liver functions, decreasing the high accumulation of lipids which caused by high fat diet and also improving antioxidant enzyme defense system.

Immune enhancer

Roots extracts of *A. lappa* enhance the immune system function as a result of a powerful immune modulator, inulin (Majchrowicz, 1995).

Digestive system disorders

High concentration of fructo oligosaccharides (FOS), nondigestible oligosaccharides in *A. lappa* showed fermentative activity of the colonic microflora of human infants in breast-feeding and solid food consumption (Flickinger *et al*., 2002). The selective fermentation of inulin by the human colonic microflora leads to a shift in the composition of the indigenous bacterial ecosystem, in favor of health-promoting bifidobacteria. In addition, there are other physiological advantages, including improved mineral absorption, enhanced natural host defenses and colonic protection, improved gut health (Alexiou and Franck, 2008).

Skin conditions

A. lappa is utilized in the treatment of various dermatopathies, including acne, seborrheic and foruncular dermatitis. This is probably because of its depurative and detoxifying action, stimulating hepatobiliary secretions and diuresis, although it remains unclear with which mechanism the herb exerts its activity (Pugliese, 1995). The plant is effective in treating acne and is the most important herb for treating all forms of chronic skin problems. *A. lappa* roots contain polyacetylenes, antifungal and antibiotic qualities that help fight acne-causing bacteria and fungi that infect cracked skin. Its diuretic action aids in eliminating impurities through the digestive system, rather than the skin where toxins can cause infections (Chevallier, 2000).

Culinary Uses

In the second half of the 20th century, the plant achieved international recognition for its culinary use due to the increasing popularity of the macrobiotic diet, which advocates its consumption. Carrot-like roots of *A. lappa* is commonly cooked and eaten as a vegetable in Asia (Silva *et al.,* 2013). The plant stem is edible and its young leaves could be used in some kinds of foods (Haghighi and Mozafariyan, 2011). The tap root of young plants can be harvested and eaten as a root vegetable. While generally out of favor in modern European cuisine, it remains popular in Asia.

Plants are cultivated for their slender roots, which can grow about one meter long and two centimeters across. *A. lappa* root is very crisp and has a sweet, mild, and pungent flavor with a little muddy harshness that can be reduced by soaking julienned or shredded roots in water for five to ten minutes. Immature flower stalks may also be harvested in late spring, before flowers appear; their taste resembles that of artichoke, to which the plant is related. The stalks are thoroughly peeled, and either eaten raw, or boiled in salt water (Szczawinski and Turner, 1978). It contains a fair amount of dietary fiber (6%), calcium, potassium and amino acids (Chan *et al.,* 2011) and is low in calories. It contains a polyphenol oxidase (Zick *et al.,* 2006) which causes its darkened surface and muddy harshness by forming tannin-iron complexes.

Cosmetic Uses

Skin Cleanser: ¼ cup of root, ¼ cup dried nettle leaves, ¼ cup dried horsetail. Boil for 15 minutes in 3 cups water Strain. Add to bath water.
Hair Rinse for oily hair: ½ cup of root, ¾ table spoon (Tbsp) horsetail leaf; ¾ Tbsp chamomile, ½ cup soapwort, 1 Tbsp nettle. Make a dry mixture of the above ingredients. Throw 1 Tbsp of the herb mixture onto a cup of boiling water and boil for a few minutes, allow cooling, Strain and use to rinse hair.

Contraindications

However, *A. lappa* has also been reported to have side effects. The most commonly reported side effect of the plant is the induction of contact dermatitis. Patients suffer from contact dermatitis after extended topical use of the root oil of *A. lappa*. Another reported case was a massage liniment containing burdock extracts that caused contact dermatitis (Paulsen, 2002). There was also a case of development of anaphylaxis due to *A. lappa* consumption. A Japanese man had developed urticaria ten times after consuming the cooked plant, with redness occurring over his entire body. In addition, he experienced difficulties in breathing an hour after consuming it. It was found that this patient had a low blood pressure of 64/29 mmHg. He was diagnosed to be in anaphylactic shock (Sasaki *et al*., 2003). The use of herbs is a time-honored approach to strengthening the

body and treating disease. Herbs, however, can trigger side effects and can interact with other herbs, supplements, or medications. For these reasons, herbs should be taken with care, under the supervision of a health care provider. Several side effects may be noticed:

1. Overdose can be poisoning and may lead to symptoms of acute poisoning include phenothiazines, tricyclic antidepressants, and antihistamines (Rhoads *et al.,* 1984).
2. It may cause dermatitis and allergic/inflammatory responses to certain people with contact as a result of lactones which the plant produces (Chan *et al.,* 2011).
3. Do not use the plant if you are pregnant or breast feeding (Chan *et al.,* 2011).

i. Herb-Food interaction

The use of burdock as a food is considered safe. The roots contain significant amounts of fiber that can help keep the bowels regular and promote growth of healthy bacteria in the colon. In fact, the root consists of nearly 40-50 inulin (Alexiou and Franck, 2008).

ii. Herb-Disease interaction

Pregnant or nursing women should avoid the plant as it may cause damage to the fetus. People who are dehydrated should not take burdock because the herb's diuretic effects may make dehydration worse (Information for pregnant women, 2009).

iii. Herb-Herb interaction

Because the roots of *A. lappa* closely resembles those of *Atropa belladonna*, there is a risk that *A. lappa* preparations may be contaminated with these potentially dangerous herbs. Be sure to buy products from established companies with good reputations, do not gather burdock in the wild (http://www.goldenlotusherbs.com). The study species may cause excess fluid loss or electrolyte imbalances when used with other diuretic herbs or supplements such as artichoke, celery, corn silk, couch grass, dandelion, elder flower, horsetail, juniper berry, kava, shepherd's purse, uva ursi, or yarrow. Because *A. lappa* may contain estrogen-like chemicals, the effects of other agents believed to have estrogen-like properties may be altered. Possible examples include alfalfa, black cohosh, bloodroot, hops, kudzu, licorice, pomegranate, red clover, soy, thyme, white horehound, and yucca.

iv. Herb-Drug interaction

Burdock has been shown to interact with hypoglycemic drugs, anti-inflammatory medications and lithium therapy, when taken internally.

There are no known scientific reports of interactions between *A. lappa* and conventional medications. However, you should talk to your doctor before taking the plant if you take any of the following:
1. Diuretics (water pills); *A. lappa* could make the effect of these drugs stronger, causing you to become dehydrated.
2. Medications for diabetes; *A. lappa* might lower blood sugar, resulting in hypoglycemia (http://www.goldenlotusherbs.com).
Based on animal research, *A. lappa* may increase the risk of bleeding when taken with drugs that increase the risk of bleeding. Some examples include aspirin, anticoagulants such as warfarin or heparin, anti-platelet drugs such as clopidogrel, and non-steroidal anti-inflammatory drugs such as ibuprofen, or naproxen. Tinctures of *A. lappa* may contain high concentrations of alcohol (ethanol), and may lead to vomiting if used with disulfiram or metronidazole (http://www.livingnaturally.com).

CONCLUSION

This article reviewed A*. lappa* was promising medicinal plant in Egypt. It has a wide range of pharmacological activities which could be utilized in several medical applications because of its effectiveness and safety.

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