NBU Journal of
Plant Sciences

Vol. 8, No. 1 March 2014 p. 83-89
ISSN No: 09746927

# Antioxidant Potential of Canna: an overview

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**Abstract**
*Canna*, the solitary genus of the family Cannaceae and order Zingiberales, comprises of about 51 species of flowering plants. *Canna* species are native of South America but with the course of time they have been distributed throughout the world. It is an important plant not only from the ornamental point of view but also it is an important plant for starch production as well as its medicinal values. From the primitive time, village people commonly use Canna as herbal medicines in their daily dealings. Different plant parts like rhizome and leaves of Canna have been used for the treatment of inflammatory diseases, fever, hypertension, diabetes, menstrual disorders, malaria etc. Phytochemicals with high antioxidant activities reported from the members of genus Canna. Moreover, isolation and identification of chemical compounds shows the presence of derivatives of polysaccharide, anthocyanin and phenylpropanoid compounds. The present study reflects a comprehensive review on biological activities of Canna species with special reference to some other members of Zingiberales.

**Keywords**: Antioxidant, Canna, phenol, flavonoids, anthocyanin

## Introduction

Oxidation is a necessary evil, which is essential for biological energy production in most of the living organisms, but excessive reactive oxygen species produced in different oxidative reactions are accountable for various health hazards to human life causing the development of degenerative diseases (Chang and Slikker, 1995). Antioxidant can slow down or terminate the activity of the oxidative chain reactions by way of removing free radical intermediates by being oxidized themselves. These processes usually occur in human body and are constantly inhibited by an efficient network of antioxidant (Bagul *et al.*, 2005). Plants often contains good amount of antioxidants. Different bioactive phytochemicals like phenols, flavonoids, carotenoids, proanthocyanidins, flavonols and ascorbic acid can be utilized to scavenge the excess free radicals from human body (Pratt, 1992). Keeping these views in mind, uptake of phytochemicals has increased significantly since it might drift the balance towards a sufficient antioxidant status (Goyal *et al.*, 2010).

Human plant intimate relation begins from the prehistoric period. With the development of social and cultural sense in primitive men, their dependence on plant resources for food, fodder, fuel, drug and shelter also increased. In this early part of twenty first century, with increased globalization and modernization, our society has a great concern for human health. So there is a demand for healthy food habit. Plants have been considered to be the major source of natural food containing large quantities of antioxidants (Larson, 1988 and Middha *et al.*, 2009). Uptake of phytochemicals has increased significantly to maintain sufficient level of natural antioxidants. Therefore plants have gained immense importance for their efficiency to produce high quality of herbal food. Among all, Canna is one of such plants, producing large quantities of starch and natural antioxidants.

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## The family Cannaceae

*Canna*, the only genus of the family Cannaceae, is popularly known as an ornamental plant with beautiful flowers. Various morphological, cytological and taxonomical characteristics of family Cannaceae is closely related to other members of Zingiberales like Musaceae, Strelitziaceae, Lowiaceae, Heliconiaceae, Zingiberaceae, Costaceae and Marantaceae (Cronquist, 1981). It

has long been recognized as a distinct, monophyletic group closely related to the family Marantaceae based on results of phylogenetic analyses of molecular and morphological data (Prince, 2010). Thus, Cannaceae is accepted by all taxonomists as a distinct entity at the family level within Zingiberales, with all types of proposed taxonomic classification (Kress, 1990). The members of the order Zingiberales like banana, turmeric, ginger etc. are very popular for their medicinal values (González-Montelongo *et al.*, 2010; Yan and Asmah, 2010; Nagendra chari *et al.*, 2013).

**Ethnomedicinal uses of Canna**

The beautiful ornamental Canna has gained its economic importance in terms of food and herbal medicine. From the earlier days Canna has been used as traditional medicine in different parts of Asia, more specifically in Southeastern Asian countries like Thailand, Malaysia, Japan, Vietnam etc. In India, the Manipuri community of Barak valley of Assam used crushed root to treat fever (Choudhury *et al.*, 2010). In northern India, the rhizome is used by the rural people to cure hypertension, menstrual disorders. Canna root is also popular as an anti-inflammatory agent (Singh *et al.*, 2010). In Thailand, Canna root has also been used as a medicine for treating diabetes (Purintrapiban *et al.*, 2006). In Iraqi traditional medicine the whole plant is used as diuretic, demulcent and sudoforic agent (Al-Douri and Al-Essa, 2010). Not only in Asia but also in other continent like Africa, ornamental Canna is used traditionally by the local people for curing various ailments. Canna plays a very important role in Nigeria as its extract is locally used to cure malaria. Further, Canna is an excellent folk medicine to control birth rate (Lawal *et al.*, 2010). Though Canna is used as traditional medicine throughout the world but the scientific evidence is restricted. So it's the time of great concern for the researchers to explore this area scientifically.

**Phytochemical constituents & Antioxidant activities**

Various experiments have been carried out to isolate and identify different compounds of ornamental and edible Canna. Srivastava and Vankar in 2010a isolated six methylated anthocyanin glycosides from red *Canna indica* flower. These compounds are malvidin 3-0-(6-0-acetyl-b-D-glucopyranoside)-5-0-b-D-glucopyranoside, malvidin 3,5-0-b-D-diglucopyranoside, Cyanidin-3-0-(600-0-a-rhamnopyranosyl)-b-glucopyranoside, Cyanidin-3-0-(600-0-a-rhamnopyranosyl)-b-galactopyranoside, Cyanidin-3-0-b-glucopyranoside, Cyanidin-0-b-galactopyranoside. From the bright red flower of *Canna indica*, Srivastava and Vankar in 2010b further isolated and identify four different compounds of anthocyanin pigments other than quercetin and lycopene. These compounds are Cyanidin-3-0-(6"-0-α-rhamnopyranosyl)-β-glucopyranoside, Cyanidin-3-0-(6"-0-α-rhamnopyranosyl)-β-galactopyranoside, Cyanidin-3-0-β-glucopyranoside, Cyanidin-0-β-galactopyranoside. In 2004 Sook and his coworkers isolated two phenylpropanoid sucrose esters namely 3-0-p-coumaroyl-6-0-feruloyl-b-D-fructofuranosyl 6-0-acetyl-a-D-glucopyranoside and 3,6-di-0-p-coumaroyl-b-D-fructofuranosyl 6-0-acetyl-a-D-glucopyranoside from dry rhizome of *Canna edulis* Ker Gawler (Sook *et al.*, 2004). Along with the above compounds one phenylpropanoid sucrose ester, four phenylpropanoids i.e. caffeic acid, rosmarinic acid, caffeoyl-4'-hydroxyphenyllactic acid and salvianolic acid and a sucrose ester derivative were also isolated (Sook *et al.*, 2004). A number of different terpenes such as monoterpenes, sesquiterpene, diterpene and some fatty acid along with their ester derivatives from the essential oil of *Canna indica* rhizome were identified by Indrayan and his group in 2011 (Indrayan *et al.*, 2011). Zhang and his coworkers isolated a novel compound i.e. 4-(3-(3,4-dihydroxyphenyl)acryloyl)-6-hydroxy-1-methoxy-1,2,3,4-tetrahydronaphthalene-2-carboxylic acid from the aqueous extract of *Canna edulis*. Some phenolic compounds were also isolated from the same plant by Zhang and his coworkers. These compounds were identified as ferulic acid, 1-caffeoylquinic acid, 3-caffeoylquinic acid, 4-caffeoylquinic acid, 5-caffeoylquinic acid, salicylic acid and gallic acid (Zhang *et al.*, 2011). Subsequently, Zhang confirmed the antioxidant

activities of the isolated compound of *Canna edulis* rhizome. So due to the presence of above mentioned antioxidative compounds in Canna rhizome, it might be considered as a ideal plant having great pharmaceutical potential. Further, antioxidant compounds in banana, turmeric and ginger were also studied. Various phytochemicals were found in commercial banana (*Musa cavendis*) and was proved to be a good source of natural antioxidants (Lewis *et al.*, 1999; Someya *et al.*, 2002 and Veneziano *et al.*, 2004). Chandraju and his coworkers in 2011found considerable amount of sugar compounds like glucose, fructose, sucrose and maltose from banana peel (Chandraju *et al.*, 2011). Further research proved banana as a natural food colorant due to the presence of different anthocyanin pigments (Alexandra *et al.*, 2001). Some bioactive compounds like curcuminoids (curcumin, desmethoxycurcumin and bisdesmethoxycurcumin) and gingerols (6-gingerol, 8-gingerol, 10-gingerol) were isolated from turmeric and ginger through high performance liquid chromatography. All the compounds were proved as therapeutical significant molecules (Wichitnithad *et al.*, 2009; Jayaprakasha *et al.*, 2002a; Hiserodt *et al.*, 1998; Jitoe *et al.*, 1992 and Schwertner and Rios, 2007).

Silica gel column chromatography is a traditional method used to purify individual chemical compound from a mixture of compounds. It is basically meant for the separation and purification of organic compounds on the basis of their polarity level. Low cost and disposability of silica gel attract the researchers to use as stationary phase in column chromatography. Though silica gel column chromatography is suitable for compound separation, it is a time consuming process and sometimes gives poor result due to band tailing (Clark *et al.*, 1978). Though separation and purification of antioxidant compounds was not studied in Canna, Bhattacharya and his coworkers separated the mixture of organic molecules in zinger, on the basis of their polarity level. They further investigated the presence of phytochemical constituents and *in vitro* antioxidant activities of these solvent fractions and concluded ginger to be a therapeutic agent (Bhattacharya *et al.*, 2009).

Although Canna rhizome has long been used as a commercial source of starch, production of high quality food items has not yet received attention from researchers. So much interest is to be given in the direction of prospective food research in Canna. Recently this line of research starts by Atrooz. In 2007, Atrooz investigated the antioxidants like polyphenols and flavonoid contents of methanolic extracts of plant seeds of *Canna indica* (Atrooz, 2007). Vankar and his co-worker performed the phytochemical constituents and antioxidant activity of methanolic extracts of red and yellow varieties of *Canna indica*. They carried out the comparative study of total phenol, flavonoid and antioxidant activity by 1,1-Diphenyl-2-picrylehydrazyl (DPPH) assay and Trolox equivalent antioxidant capacity (TEAC) assay. (Vankar and Srivastava, 2008). Some pharmacological studies such as laxative, cardiotonic activities, for investigation of total polyphenolic contents and antioxidant activities of edible flower extracts has been done. *In vitro* Antioxidant Activity of methanolic extract of aerial parts of *Canna indica* was studied by Joshi and his coworkers in 2009 (Joshi *et al.*, 2009). The antioxidant activity of the seed extract of *Canna indica* was evaluated for their antioxidant activity by DPPH radical scavenging activity, reducing power, RBC's hemolysis and linoleic acid oxidation along with the determination of the phenolic and flavonoid contents. All these experiments showed strong antioxidant activity and high content of phenolics and flvonoids (Atrooz, 2009). Indrayan and his co-workers studied the antibacterial activity of the essential oil of *Canna indica* rhizome showing inhibitory effect against some important gram positive and negative bacteria (Indrayan *et al.*, 2011).

Despite the uses of Canna as food and folk medicine for human, it is also utilized as an alternative for conventional antibiotics in animal husbandry.

Till date we know very little on the phytochemical constituents of Canna, but it has been well explored in close Zingiberales. Research on some members of zingiberales showed that they have considerable amount of antioxidants. Someya and his coworkers had studied the presence of total phenolics and

antioxidant activities in banana. They found that both phenolics and antioxidant activities were more abundant in peel than in pulp. High antioxidant activity in banana is attributed to its phenolic content (Someya *et al.*, 2002). Presence of different phytochemicals, high antioxidant activities and antibacterial activity in banana was further investigated by various scientists (Kanazawa and Sakakibara, 2000; Mokbel and Hashinaga, 2005; Vijayakumar *et al.*, 2008 and González-Montelongo *et al.*, 2010). Some other Zingiberales like turmeric, zinger is also proved to have some antioxidant activities. Turmeric, basically a spice is well known for its medicinal properties. In India and China, it is long been used as a herbal medicine for various ailments like cough, anorexia, diabetic wounds, hepatic disorders and rheumatism etc. High antioxidant and antiradical activity found in turmeric was because of the presence of higher amount of polyyphenolic compounds. Curcumin, a major component of *Curcuma longa* is a natural antioxidant having antimutagenic, antitumor, anti-inflammatory, antiparacitic, antispasmotic and antibacterial activities. It was investigated that turmeric extract reduces lipid peroxidation by enhancing the antioxidant enzymes. Turmeric leaf was also studied to have higher antioxidant activities (Jayaprakasha *et al.*, 2002b; Ruby *et al.*, 1995; Chattopadhyay *et al.*, 2004; Araujo and Leon, 2001; Pulla Reddy and Lokesh, 1994 and Yan and Asmah, 2010). Ginger was studied for high antioxidant activity and was established as a therapeutically significant food material (Ahmad *et al.*, 2008 and Nagendra chari *et al.*, 2013).

## Conclusion

A series of work have been carried out by different scientists on different members of Zingiberales showed their efficiency as potential medicine. As a member of Zingiberales, we must think that Canna may have some therapeutic uses. Though Canna is popular as an ornamental plant, the Indian tribes like Lepchas, Bhutias and Nepalis consume the starchy rhizome as their regular food (Sekar and Mariappan, 2007). Since decade it has fascinated the attention of researchers, worldwide due to its nutritional and medicinal values. Some work on dietary uses and medicical values of Canna has been carried out but review of literature did not provide any substantial work on nutritional values and antioxidative properties of different species and cultivars found in eastern India. So scientific experiments and validation are essential to ensure Canna as a safe food additive and have significant role in the pharmaceutical and nutraceutical industries. Thus, a lot of research needs to be explored on detailed antioxidative properties of different cultivars of Canna found in the eastern part of India.

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