



ETHNOMEDICINAL AND THERAPEUTIC VALUES OF *FLACOURTIA JANGOMAS*

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Date of online publication: 31st December 2020

DOI: 10.5958/2455-7218.2020.00037.6

Among the plants often used in traditional medicine, *Flacourtia jangomas* (Lour.) Raeusch., distributed throughout tropical regions of East Africa and Asia is well-known for its ethnomedicinal and therapeutic uses. Several studies showed that *F.jangomas* has diverse array of chemical compounds. The aim of the review is to present an updated and comprehensive overview of ethnomedicinal significance, phytochemical and pharmacological aspects of *F. jangomas* to highlight its ethnopharmacological use and to explore its therapeutic potentials thereby providing a basis for future research. Relevant information and literature on *F. jangomas* from electronic databases such as Academic Journals, Google, Google Scholar, PubMed, Web of Science, and Science Direct were consulted and analyzed. Available literatures evidently demonstrate that *F. jangomas* possess a wide spectrum of pharmacological activities that could be observed by the presence of varied range of chemical constituents. Phytochemical and pharmacological investigations showed that extracts of different parts and major active components of *F. jangomas* had antimicrobial, antidiabetic, antidiarrheal and antioxidant activities. This emphasizes the need for further investigation to explore more bioactive chemical constituents and new bioefficacies of the plant and to establish a credible relationship between molecular structure and activity of compounds.

Keywords: Ethnomedicine, *Flacourtia jangomas*, Pharmacology, Phytochemistry

Plants have been used as a source of medicine from ancient to contemporary age. Initially, these were the main part of folk or ethnomedicine, practiced in India and other parts of the world like China, Middle East Africa and South America. Later, substantial part of such indigenous knowledge was organized, documented and eventually passed into the organized systems of medicines such as Ayurveda, Chinese, Yunani, Sidha, Tibetan or other systems (Cantel *et al.* 2005). Despite significant development of rural health services, village people still use herbal folk medicines to a good extent for treatment of common ailments like cough, cold and fever, headache and body-ache, constipation and dysentery, burns, cuts and scalds, boils, ulcers, skin diseases and respiratory troubles and others (Tripathi and Puni 2010). Over the last decade, there has been a paradigm shift from synthetic drug molecules to the traditional and complementary system of medicine (Cordell and Colvard 2012). The revival of these medicines can be due to the irrational use of the chemical drugs leading to microbial resistance, lack of modern curative therapies for the treatment of chronic diseases and the awareness among people prevent themselves

various diseases (Ali *et al.* 2015). Furthermore, the technological advancement in the area of phytomedicine and alternative therapies has made an impact on the scientific fraternity for future discoveries of potent bioactive molecules for curing various ailments (Yuan *et al.* 2016). It is estimated that 25% of the crude drugs used in recent years are derived from plants, of which 5-15% have been explored for bioactive compounds (Veeresham 2012). According to WHO, China, Africa, Indonesia, India, Japan, Singapore, the Republic of Korea etc. are some countries, where more than 50% of the population relies upon their traditional and complementary system of medicines. Therefore, directives and unified efforts in assuring their quality control, stability and standardization parameters are the need of the hour (Baldi and Singh 2017). Among the plants often used in traditional medicine, *Flacourtia jangomas* (Lour.) Raeusch. belonging to the genus *Flacourtia* is known to have diverse therapeutic value. The genus was formerly named in the honour of Étienne de Flacourt (1607–1660), a governor of Madagascar and was placed in the now defunct family Flacourtiaceae (Mitra 1933). It is native to the African and Asian tropics and subtropics.

Several species of the genus are cultivated for their fruits and as ornamentals.

Botanical description

F. jangomas (Lour.) Raeusch commonly known as Paniala or Indian plum or Coffee plum belongs to the family Flacourtiaceae (now placed in Salicaceae) (Hantel 2001, Chandra and Bhanja 2002). It is a small deciduous tree growing up to 6-10 m but occasionally reach up to 14 m in height. Trunk and branches of old trees are thorn less whereas woody thorns are present when young. Leaves are alternate, deciduous, pale pink when young, spirally arranged, rarely ovate-lanceolate, long point toothed, very thin, both surfaces glossy, blade elliptic, serrate. Inflorescence is axillary racemes, subcorymbose, glabrous. Flowers are dioecious, white to greenish in colour comprising 4 or 5 ovate triangular petals bearing fragrance of honey before or with the young foliage. Male flowers are filaments, glabrous and solitary or in clusters while female flowers are solitary. Male and female flowers are on separate trees. Flowers appear from December to April together with new leaves with very beautiful fresh green colour. Fruits are ellipsoid berries, sub-globose, dull brownish red or purple, then blackish, with greenish-yellow pulp ripening from March to July, enclosing 4-5(-10) flat seeds. The tree is propagated through seeds. However, seeds are slow to germinate; therefore, propagation is usually by inarching or budding onto self-seedlings. Ripe fruits are eaten by birds and widely dispersed thus facilitating very wide distribution of the species (Hossain *et al.* 2011).

Origin and distribution

F. jangomas is lowland semi-cultivated fruit tree with uncertain wild confinement. Its wild origin is unknown however it is said to have originated from India and distributed throughout tropical regions of East Africa and tropical Asia. It is indigenous to North-eastern Terai region of Utter Pradesh, Bihar, Maharashtra, Bengal, Assam and Orissa states

and some parts of South India. It is often found in the Brahmaputra valley of Assam and adjoining areas of Northeast region of India (Dutta and Borah 2017). It has naturalized in areas such as Hawaii, New Caledonia, Cook Islands, La Reunion and warmer coastal districts of eastern Australia where it is occasionally cultivated usually as a rare and exotic fruit tree.

Ethnopharmacology

F. jangomas is an important fruit tree having immense nutritional and medicinal significance. In the Indian system of medicine, fruits are regarded as alleviator of vitiated doshas and toxic conditions. The fruits are used in bilious conditions and in diarrhoea. It is also used in the treatment of bleeding gum, toothache, diabetes and the leaves after decoction are used in the treatment of diarrhoea, dysentery and piles (Kirthikaret *al.* 1933). Different parts of the plant are pharmaceutically used for the treatment of asthma, pre-and post-natal blood purification and many other ailments (Jain 1991). Barks are used for the treatment of intermittent fever. The roots are sweet, refrigerant, depurative alexipharmic and diuretic. They are useful in asthma, anaemia and so on. The leaves and young shoots, which taste like rhubarb, are astringent and stomachic. The fruits are used to overcome digestive disorders, allay thirst, biliousness, fevers, nausea and diarrhoea (Ghani 2003, Srivastava 2009). The leaf decoction is taken to halt diarrhoea. Powdered roots are used as poultice on sores and skin eruptions and held in the mouth to soothe toothache. Decoction of the bark is useful in biliousness, bleeding gums, toothache, piles and weakness of limbs (Yusuf 1994). The leaves and bark are used in the treatment of diarrhoea, bleeding gums, toothache, piles and weakness of limbs and applied on bleeding gums and aching teeth, and the bark infusion is gargled to alleviate hoarseness (Yusuf 2007). Powdered dried leaves are employed to relieve bronchitis and cough. Fruits hold a notable

status in the treatment of stomachic and digestive; allay thirst, useful in biliousness, fevers and relieves nausea. The fruits are eaten in Burma to promote digestion. In India, dried leaves are used to treat asthma (Yusuf 2007). In Malaysia, a decoction of leaves is used as a drink to treat diarrhoea, to promote digestion and the juice squeezed from the roots is used to treat herpes infection. A paste of roots is applied to sores, ulcers, and to soothe an inflamed throat. Fruits are given in jaundice and enlarged spleen. Ground bark paste is also used for curing many common ailments in the Tribal settlements of Western Ghat. Fruits are also used in liver related disorders (Srivastava 2009). The plant is astringent, acrid, sour, refrigerant, and stomachic and used for a variety of, ailments like diarrhoea, inflammation, skin disease, jaundice, tumours, nausea, dyspepsia and diabetes in south Indian traditional medicine (Singh *et al.* 2010). The leaves and bark are slightly acid and acrid are useful for bleeding gums and toothache.

Phytochemistry

F. jangomas is one among that plants which have not been adequately explored scientifically. Studies so far have shown that the Flacourtiaceae elaborates a diverse array of compound classes which include terpenoids, alkaloids, flavonoids and tannins, lignans and flavanolignans, glucosides, coumarins and isocoumarins. The plant contains tannin and a fixed oil whereas the bark principally contains tannins; leaves and young shoots are also rich in tannins (Ghani 2003). There have also been reports of xanthenes, quinones, limonoids and phenazines. Two limonoids, namely limolin and jangomolide were reported from the stem and bark of *F. Jangomas* (Ahmad *et al.* 1984). The bioactive compounds including corymbulosine, tremulacin, hydnocarpic acid, chaulmoogric acid have been reported in *F. jangomas*. The fruit and stem bark yielded a coumarin named ostruthin (Khare 2007). The phenolic glucoside ester, flacourtin was reported in bark whereas, a butyrolactone

lignan disaccharide named ramontoside and steroids including β -sitosterol and its β -Dglucopyranoside were reported in the heartwood (Pandey and Dubey 2014). Fruits were reported to be rich in nutrients, protein, fat, sugars (fructose, α - and β -glucose and sucrose), amino acids, vitamin C and minerals including calcium, potassium, phosphorous, iron, magnesium, sodium, manganese, copper, and zinc (Ghani 2003, Kermasha *et al.* 1987). Analysis of fatty acids in fats revealed the presence of palmitic, hexadecadienoic, stearic, oleic, linoleic, alpha-linolenic, and a few minor unidentified acids. Further, amino acids from extract of dried ripe fruits showed the presence of proline, hydroxyproline, methionine, alanine, glycine, and valine. Paper chromatography studies on simple reducing sugars and their alditol acetates indicated the presence of arabinose, glucose, fructose and galactose (Dinda *et al.* 1989). The ripe fruits of *F. jangomas* contain good amount of potassium, having high bioavailability and thus, may serve as a good source for sufficient potassium intake (Srivastava 2009).

Therapeutic values

F. jangomas is therapeutically regarded as astringent, acrid, refrigerant, stomachic, diaphoretic, analgesic, stomachic, antiinflammatory, and antimicrobial. It is used for the treatment of skin diseases, diarrhoea, toothache, jaundice asthma and tumours (Shirona 2014). Fruits are traditionally considered to be antidiabetic (Jeyachandra and Mahesh 2007). The ripe fruits have high fiber content together with good protein content, low fat and higher amount of monounsaturated fatty acids as compared to polyunsaturated fatty acids. It contains a significant amount of beta-carotene followed by lutein and zeaxanthin, retinol and phyloquinone (vitamin K) which are important in the regulation of hemoglobin and fibrinogen in the human body. Besides, ascorbic acid (vitamin C) and niacin (vitamin B₃) are also present in significant amounts. Ripe fruits contain a good amount of

potassium which has a definite role in the regulation of blood pressure followed by phosphorus and magnesium having their role in controlling osteoporosis. The plant and some of its active chemical constituents have been investigated for various pharmacological properties including anti-inflammatory, antibacterial, anti-diarrheal, antiviral, antioxidant, and anti-amylase activity (Jeychandran and Mahesh 2007). Pharmacological studies of various parts of the plant as summarized hereunder.

Antibacterial activity

Antibacterial activity of the crude extract of *F. jangomas* has been studied against both gram-positive and gram-negative bacteria, which showed good antibacterial activity against *Shigella shiga* and *Bacillus megaterium* and moderate activity against *Bacillus cerus* and poor activity against *Escherichia coli* (Dinda *et al.* 1989). Further, there is also report about the chloroform fraction of the root extract showing strong antimicrobial activity against pathogenic bacteria (Sarker *et al.*, 2011). Fruit extract of the plant reported to exhibit good antimicrobial activity against *Pseudomonas aeruginosa*, *Klebsiella pneumonia* and *E. coli* (Srivastava *et al.* 2012). In another study, bacterial endophytes FjF2 and FjR1 isolated from roots showed broad spectrum antimicrobial activity against clinical pathogens gram positive (*Staphylococcus aureus*, *S. aureus*) and gram negative (*E. coli*, *Pseudomonas sp.*, *Proteus vulgaris*, *Klebsiellasp.*) bacteria thus indicating promising antimicrobial activity of the bacterial endophyte isolates against human pathogenic bacteria (Shukla *et al.* 2015).

Antifungal activity

Fungal infections have been in the rise destroying the peace of the healthy world for the past few decades. Despite knowing they are life threatening they are neglected pathogens. Immuno compromised patients are at a higher risk to these infections owing to their weakened

immune system. The increased use of antibiotics and immunosuppressive drugs are a reason for the greater rate in the emergence of fungal infections as these drugs disrupt the normal bacterial colonization and by suppressing the immune system of the body create an environment in the body where fungi can thrive its best. They become multidrug resistant strains (MDR). The eukaryotic fungal cells have great similarities with mammalian cells, so this makes the therapeutic approach to these diseases very difficult. Methanol extracts of different parts of *F. jangomas* including leaf, flower, bark and root were evaluated for antifungal efficacy against *Candida tropicalis*, a resistant strain that ranks second or third causative agent of many candidal infections and several oral diseases such as dental caries, endodontic infections, periodontal diseases and oral candidiasis (Akpan and Morgan 2002).

Antidiabetic activity

Study on the effect of methanolic extract of *F. jangomas* leaves and stem (1:1) in alloxan-induced diabetic rats using glibenclamide as standard antidiabetic agent. Antidiabetic potency of the extract was assessed by fasting blood glucose (FBG) level. The result demonstrated that methanolic extract induces significant decrease of blood glucose level in diabetic rats and this effect was more potent after repeated dose (200 mg/kg and 400 mg/kg) administration, a marked reduction of blood glucose level in these rats was achieved after 14 d of treatment (Singh *et al.* 2010).

Antidiarrheal activity

In vivo antidiarrheal test of ethanolic extract of *F. jangomas* leaves by castor oil induced diarrhoeal model showed significant ($P < 0.001$) increase in onset of diarrhoea and reduction in frequency of defecation as compared with control in dose dependent manner. The extract exhibited 74.05 and 85.50% inhibition of defecation at the doses of 250 and 500mg/kg, respectively while standard loperamide showed 88.00%

inhibition of defecation at the dose of 3mg/kg thus clearly indicating promising antidiarrheal activity as substantiated by the prolongation of latent period as compared with control and standard (Talnkdar *et al.* 2012).

Antioxidant activity

Ethanol extract of leaves of *F. jangomas* exhibited a significant DPPH radical scavenging activity in concentration dependent manner with IC₅₀ value of 11 µg/ml whereas the IC₅₀ value for the standard ascorbic acid was 5 µg/ml. A comparative study of total phenol, total flavonoid contents and antioxidant potential of different extracts including chloroform, petroleum ether and methanol extract of *F. jangomas* using DPPH radical scavenging assay, reducing power method, total antioxidant capacity showed moderate to good antioxidant activity of extracts as compared to ascorbic acid. The IC₅₀ value of the chloroform, methanol and petroleum ether extracts were 523.15, 1623.87 and 5811.35 µg/ml respectively while, the IC₅₀ value of well-known antioxidant Ascorbic Acid was 13.37 µg/ml (Rahman *et al.* 2012). Different studies show that different types of polyphenolic compounds (flavonoids, phenolic acids) found in plants have multiple biological effects, including antioxidant activity of *F. jangomas* (Vinson *et al.*, 1995). Though, it has been determined that the antioxidant effect of plant products is mainly due to radical scavenging activity of phenolic compounds such as flavonoids, polyphenols, tannins, and phenolic terpenes (Rahman and Moon 2007). In DPPH test, which is based on the ability of DPPH, a stable free radical, to decolorize in the presence of antioxidants, is a direct and reliable method for determining radical scavenging action. Chloroform extract of *F. jangomas* showed good DPPH scavenging activity where ascorbic acid was chosen as the reference antioxidant for this test. Antioxidant efficacy of different parts of the plant was studied using DPPH and ABTS radical

scavenging assay; of which the flower extract of *F. jangomas* showed significant antioxidant potential with IC₅₀ values of 11.16±0.54 µg/ml and 12.34±0.37 µg/ml for DPPH and ABTS assays (George *et al.* 2017).

CONCLUSION

Medicinal plants have been used for centuries as remedies for human diseases because they contain components of therapeutic value. The curative properties of medicinal plants are attributable to the presence of various bioactive phytochemicals which may explain their traditional uses against various ailments. In this review article, effort has been taken to collect and compile the details regarding ethnomedicinal, phytochemical and therapeutic facets of *F. jangomas*, a less explored plant (Sauco 2008); however, has received interest owing to its diverse ethnomedicinal significance and presence of many biofunctional phytochemicals. Literature search has shown that the plant has immense medicinal uses in different systems of medicine in India as well as throughout the world. Bioactive chemical constituents isolated and characterized so far from the plant and a variety of pharmacological activities, including antibacterial, antifungal, antidiabetic, antidiarrheal and anti-oxidant are presented in this review. Therapeutic uses determined by studies of the crude extracts and compounds isolated from *F. jangomas*. Extensive research with regard to isolation and characterization of the active principles responsible for the activity and to understand the precise mechanism of the therapeutic action is required so that better, safer and cost-effective drugs can be developed. Pharmacological findings evidently indicate that the plant extract and some of its biofunctional constituents can be formulated which will be useful to the society to venture in to a field of alternative systems of medicine.

REFERENCES

- Ahmad J, Wizarat K, Shamsuddin KM, Zaman A and Connolly JD 1984 Jangomolide, a novel limonoid from *Flacourtia jangomas*. *Phytochem* **23** 1269-70.
- Akpan A and Morgan R 2002 Oral Candidiasis-Review. *Postgrad Med J* **78** 455-9.
- Ali K, Maedeh M and Mahmoud R K 2015 Herbal versus synthetic drugs: Beliefs and facts. *J Nephroarmacol* **4** 27-30.
- Baldi A and Singh P A 2017 Evidence based pharmacology of herbal formulations: Need of the hour. *J Compl Med Alt Healthcare* **3(5)** 555-624
- Canter P H, Thomas H and Ernst E 2005 Bringing medicinal plants into cultivation: opportunities and challenges for biotechnology. *Trends Biotechnol* **23** 180-5.
- Chandra I and Bhanja P 2002 Study of organogenesis in vitro from callus tissue of *Flacourtia jangomas* (Lour.) Raeusch through scanning electron microscopy. *Curr Sci* **83** 476-9.
- Cordell G A and Colvard M D 2012 Natural products and traditional medicine: Turning on a paradigm. *J Nat Prod* **75(3)** 514-525.
- Dinda B, Banerjee J, Pal J and Mahanti A 1989 Chemical composition of *Flacourtia jangomas* fruits. *J Food Sci Technol* **26** 334-6.
- Dutta B and Borah N 2017 Studies on nutraceutical properties of *Flacourtia jangomas* fruits in Assam. *India J Med Plants Stud* 550-3.
- George S A, Bhadrans S, Sudhakar M and Harini BO 2017 Comprehensive in vitro evaluation of pharmacological activities of selected plant extracts and GC-MS profiling of *Flacourtia jangomas* flower extract. *Asian J Pharm Clin Res* **102** 37-44.
- Ghani A 2003 *Medicinal Plants of Bangladesh*. 2nd ed. The Asiatic Society of Bangladesh Pp 1-17.
- Hanelt P 2001 Mansfeld's Encyclopedia of Agricultural and Horticultural Crops: (Except Ornamentals), *Institute of Plant Genetics and Crop Plant Research*. Eds. *Springer* 3700.
- Hossain M A, Sen S, Jewel M I U and Kabir M A 2011 Propagation of *Flacourtia jangomas*: an approach towards the domestication of a wild fruit species in Bangladesh. *Dendrobiology* **65** 63-71.
- Jain S K 1991 *Dictionary of Indian Folk Medicine and Ethnobotany*. Deep Publication-New Delhi Pp 91.
- Jeyachandran R and Mahesh A 2007 Enumeration of antidiabetic herbal flora of Tamil Nadu. *Res J Med Plan* **11** 44-8.
- Kermasha S, Barthakur NN, Mohan NK and Mohan NP 1987 Chemical composition and proposed use of two semi-wid tropical fruits. *Food Chem* **26** 253-9.
- Khare CP 2007 *Indian Medicinal Plants*. *Springer Science Business Media LLC*-New York Pp. 270.
- Kirthikar K R, Basu B D and Taylor L G 1993 *Indian Medicinal Plants, 2nd eds*. *Bishen Singh and Mahendra Pal Singh*, DehraDun, India. Pp. 220.
- Mitra R L 1933 *Flacourtiaceae*. In: *Flora of India*, eds. *Sharma BD, Balakrishnan* Botanical Survey of India, Kolkata. 2 403-5.
- Pandey VN and Dubey N. Nutraceutical 2014 pharmaceutical and industrial value of coffee

- plum: *Flacourtia jangomas* (Lour.) Raeusch. *Everyman's Sci* **49** 98-104.
- Parvin S, Kader A, Sarkar G C and Gosain S B 2011 In vitro studies of antibacterial and cytotoxic properties of *F. jangomas*. *Int J Pharm Sci Res* **22** 786-90.
- Rahman M A A and Moon S S 2007 Antioxidant polyphenol glycosides from the Plant *Drabanemorosa*. *Bull Korean Chem Soc* **28(5)** 827-831.
- Rahman MM, Habib MR, Hasan MR, Islam AMT and Khan IN 2012 Comparative antioxidant potential of different extracts of *Flacourtia jangomas* lour fruits. *Asian J Pharm Clin Res* 573-5.
- Sarker G C, Zohan R, Alam M B, Islam M S, Mosaddik M A, Haque MEK 2011 Antibacterial activity of *Flacourtia jangomas* and *Flacourtia sepiaria*. *Int J Pharm Life Sci* **2** 878-83.
- Sauco V G 2008 Global overview of underutilized tropical and subtropical fruits. *Acta Hor* **770** 77-85.
- Shirona T K, Sruthy K B and Rajendran N 2014 Antibacterial and antioxidant properties of two medicinal plants from Kerala, India. *Int J Chem Pharm Sci* **5** 68-72.
- Shukla S, Naik G and Mishra S K 2015 Potential antimicrobial activity of bacterial endophytes isolated from *Flacourtia Jangomas* (Lour.) Raeusch, a less explored medicinal plant. *J Microbiol Biotechnol and Food* P473-477.
- Singh A K, Singh J, George M and Joseph L 2010 Anti-diabetic effect of *Flacourtia jangomas* extract in alloxan-induced diabetic rats. *Pharmacology online* **2** 253-9.
- Singh N S, Geetha M, Amudha P and Chakraborty A 2010 Evaluation of anti-diabetic activity of methanol extract of *Flacourtia jangomas* (lour) in streptozotocin induced diabetic rats. *Int J Pharma Biosci* **1** 1-11.
- Srivastava D, Prabhuji S K and Rao G P 2009 Taxonomic and ethnobiological status of *Flacourtia jangomas* (Lour.) Raeus. an endemic nutraceutical plant of Eastern U. P. medicinal plants. *Int J Phytomed Related Industries* **1** 49-53.
- Srivastava D, Sheikh S, Prabhuji S K, Rao GP, Tripathi A and Srivastava R 2012 In vitro antibacterial activities of *Flacourtia jangomas* (Lour.) Raeusch. fruit extracts. *Medicinal Plants-Int J Phytomed Related Industries* **4** 98-100.
- Talukdar C, Saha S, Adhikari S, Mondal H K, Islam MK and Anisuzzman M 2012 Evaluation of antioxidant, analgesic and antidiarrheal activity of *Flacourtia jangomas* (Lour.) Raeusch. Leaves. *Pharmacol Online Arch* **3** 20-8.
- Tripathi Y C, Puni L 2010 Renaissance in traditional medicine system. *MFP News* **20** 14-9.
- Veeresham C 2012 Natural products derived from plants as a source of drugs. *J Adv Pharm Technol Res* **3(4)** 200-201.
- Vinson J A, Dabbagh Y A, Serry M M and Jang J 1955 Plant flavonoids, especially tea flavonols are powerful antioxidants using an in vitro oxidation model for heart disease. *J. Agric. Food Chem* **43** 2800-02.
- Yuan H, Ma Q, Ye L and Piao G 2016 The traditional medicine and modern medicine from natural products. *Molecules* **21(5)** 559(1-18).
- Yusuf M, Chowdhury J U, Wahab M A and

Begum J 1994 *Medicinal plants of Bangladesh*, Bangladesh Council of Scientific and Industrial Research. Dhaka, Bangladesh Pp. 340.

Yusuf M, Wahab M A, Chowdhury J U and Begum J 2007 Some tribal medicinal plants of Chittagong Hill Tracts, Bangladesh. *J Plant Taxon* 14 117-28.

Zhang J, Onakpoya I J, Paul Posadzki P and Eddouks M 2015 The safety of herbal medicine: From prejudice to evidence. *Evid Based Compl Alt Med* 1-3.