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A Brief Review on Tumba

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Abstract: Present review article reveals the importance of Tumba belonging to the species Citrullus colocynthis. In this article, we have documented the uses of the Citrullus colocynthis fruit and summarized recent research into the phytochemistry and pharmacology of the fruit and nutritional value of fruit and seeds of Citrullus colocynthis. Some of the traditional uses have been validated by phytochemical and modern pharmacological studies. The extracts and isolated compounds have been found to possess various biological activities, especially in the area of antidiabetic, anticancer, anti-inflammatory, antioxidant, insecticidal and antimicrobial. Interestingly, plant has been shown to be of high nutrition value being a rich source of protein, edible quality of seed oil and some important minerals such as calcium, potassium and magnesium, known to be of high medicinal value.

Keywords: Citrullus colocynthis, antidiabetic, anticancer, phytochemistry.

Introduction: The plant kingdom has the largest genetically modified medicinal plants, and one of the most important group is Cucurbitaceae. Many plants belonging to this group cannot be grown in damp soil and in colder regions of the country, whereas it's favorable environment for growth is dry and desert areas. Bitter gourd, bitter apple, cucumber, bitter melon, and pumpkin are few of the plants that belong to family Cucurbitaceae. Citrullus colocynthis is one of the plants which belong to this group, mostly grown in dry and desert regions of the world. This plant has gained importance due to its medicinal usage and nutraceutical properties (Zaini *et.al.,* 2011). It is a desert creeper which spreads rapidly after monsoon on the desert land. Its fruits are available in the month of October and November. The pulp of the tumba fruit contains chemical agent like colocynthin, certain stable oils, resins that are not soluble in either, sticky substance like gums, lignin, pectin, certain minerals like calcium and magenesium. Their active ingredients are phytosterol, D-glucoside of beta-sitosterol, elaterin, albuminoids, amyloid principles and a bitter substance colocynthin (C56H84023, a yellowish, translucent, bitter agent) and colocynthetin. However, a heat sensitive glucoside is the most important constitute of tumba. Its seed contain phytosterolin-2 phytosterol, hydrocarbons, polysaccharides and glusides. It also contains antituberous agent like cucurbitacin-B and cucurbitacin-E (www.ayushveda.com). In Biblical times, Tumba was known as a source of seed oil and its fruits were used as a remedy of various diseases. Its seeds constitute the drug colocynth, which is used for acute & chronic constipation, for liver and gall bladder ailments (American Botanical Council 1990). The plant kingdom has the largest genetically modified medicinal plants, and one of the most important is group Cucurbitaceae. This plant has been used traditionally over the centuries for the cure of different types of cancers, diseases of liver and eye. The roots of this plant was used for the treatment of rheumatics, diseases related to kidney & liver and used to cure the snake poison. Inflammation caused by any reason, joints pain were also been treated by the roots. Roots were also been in use as remedy for amenorrhea due to its nutraceutical applications (Uma & Sekar, 2014). In past, bitter apple has been utilized for medicinal purposes as well as for heat energy. The leaves of this plant have been taken as diuretic, whereas asthma and jaundice were also been treated by them. The fruit has quite pungent smell but also have cooling effect, because of this property fruits was in use to lower the body temperature during feverish

conditions, and to treat the parasitic diseases. Fruit pulp was also been in use as laxative, diuretic and against epilepsy (Hussain *et.al.,* 2014).

Physical characteristics and management of Tumba: Citrullus colocynthis is a perennial herbaceous vine that produces small flowers. Leaves are very variable in size. Wild leaf is 3.8–6.3 cm in length and 2.5 cm in width while cultivated leaves are large in size. Leaf shows deltoid margin, pale green color above and ashy color beneath, scabrid on both surfaces, 5–7 lobed. The angular leaves are alternately located on long petioles. Each leaf is almost 5–10 cm in length and has around 3–7 lobes. Sometimes the middle lobe might have an ovate structure. The leaves have a triangular shape with many clefts. The leaves have a rough, hairy texture with open sinuses. The upper surface of the leaves is fine green color and the lower surface is comparatively pale. C. colocynthis shows the presence of male and female flowers. Fruit is globular, slightly depressed, 5–7.5 cm in diameter, green in color and gets white glabrous when ripe. Fruit filled with a dry, spongy very bitter pulp. Each bitter apple plant produces around 15–30 globular fruits having a diameter of almost 7–10 cm. The outer portion of the fruit is covered with a green skin having yellow stripes. The fruits may also be yellow in color. Seeds are 4–6 mm long and pale brown. The fruits have a soft, white pulp, which is filled with numerous ovate compressed seeds. The seeds are around 6 mm in size, smooth, compressed, and ovoid-shaped. They are located on the parietal placenta. The seeds are light yellowish-orange to dark brown in color (Pravin *et. al.,* 2013)

Nutritional composition of Tumba fruit and seed: The nutritional data are the key parameters in defining the quality of a food. Besides the medicinal uses, Citrullus colocynthis fruit is also employed as food for animals and humans (Sadou *et.al.,* 2007). For over a decade, the scientists of the United States Department of Agriculture (USDA), have investigated the nutritional and functional properties of the seeds of this plant, and concluded that they have the potential to find a place in the food industry. Nutrients in spite of the widespread importance of Citrullus colocynthis as food, little nutritional detail is readily available to an international readership. The seed kernels contain about 50% oil, 30% protein, 10% carbohydrate, 4% ash, and 3% fiber (National Research Council, 2006). Whereas Akhter *et al.,*(1999) reported that during germination of seeds in the dark at 30^0C, the relative amounts of triacyl glycerol decreased, while the free fatty acids increased continuously in significant amounts. However, it was mentioned that saturated fatty acids are increased and unsaturated fatty acids decreased gradually during germination. The protein content of seeds of colocynthis (transitional weeds) was found to be 8.25% and rich in lysine, leucineand sulfo-amino acids viz, methionine. (Shaheen *et al.,* 2003). Egusi (colocynthis) kernel contain oil (52%), protein (28.4%), fiber (2.7%). Ash (3.6%) and carbohydrate (8.2 %). (Smmons *et al.,* 1982). Citrullus colocynthis is an excellent source of different amino acids as arginine, methionine, and tryptophan .The biological indices of its protein quality have been described as: “lower than soybean but comparable to or higher than most oilseeds.” Nutritionally, the limiting amino acids are lysine and threonine (National Research Council, 2006). Sawaya (1986) reported the amino acid composition of Citrullus colocynthis protein and compared it with other oilseed proteins. Glutamic acid and arginine were the main amino acids identified with concentrations 19.8 and 15.9 g of amino acid/100 g of protein, respectively. Other major (4.5 g of amino acid /100 g of protein) amino acids found were aspartic acid, serine, glycine, alanine, leucine and phenylalanine.

Tumba seeds were also analyzed for their fatty acid composition by NIN scientists in 1990. Their finding suggest that fatty acid of Tumba seeds were high in PUFA (particularly rich in linoleic acid) and also contain good amount of fibre but low in starch (3.6-5.6%). Further, the physio-chemical characteristics and lipoxygenase activity of Tumba seeds was investigated and the study documented that the activity of enzyme reduced up to 50 percent of the original activity after roasting (Khalifa, 1995.)

Minerals are the essential nutrients that are required by the body for carrying out normal functions. Citrullus colocynthis fruits and seeds contain several micronutrients (vitamin and minerals) that could significantly contribute to the diet. The potential for Citrullus colocynthis seed as a source of calcium and niacin is encouraging to the low milk-consuming regions of lower West Africa. Potassium and Calcium are the major minerals present in the seeds, with concentrations of

569 mg and 465 mg/ 100 g of seeds, respectively. The seeds are also a rich source of magnesium and phosphorous while Iron (Fe) and zinc (Zn) contents are at the lowest level. Both of these minerals are well known to play beneficial role in maintaining electrolytic balance of body fluid as well contribute to alkalinizing the body (Zaini *et.al.,* 2011). In another report, the major mineral component from Citrullus colocynthis was found to be phosphorus, potassium, magnesium, manganese, sulfur, calcium, iron, and zinc (National Research Council, 2006). However Cristoph *et.al.,(*2005) reported that Tumba contains 2-o-beta-D-glucopyranosyl cucurbitacin I, J, K, L and Durey *et.al.,(*2006) analysed cucurbitacin B and L from the species. However, the other active principles of the fruit include gums, lignin, pectin, phytosterol, colocynthin, hydrocarbons and polysaccharides. A friable glucoside is the major constituents of Tumba (www.ayushveda.com). While Das *et.al., (*2002)examined the characteristics and the composition of the crude oil extracted from Citrullus colocynthis and reported over 75% degree of unsaturation, major among which was linoleic acid 50.6% upon the storage. The oil showed relatively low peroxide values that were within the acceptable limits set for other vegetable oils. similarly Shahid *et.al.,(*2019) reviewed that the proximate analysis and mineral content of the various parts, seeds, leaves, whole fruit and roots of Citrullus colocynthis have been discussed in this study. Whole fruit is enriched with nutrients followed by leaves, seeds and roots. The different parts of bitter melon have nutrient contents, which are Ash (4.02%- 6.02%), Fats (18.90% - 24.23%), Moisture (5.12%- 9.01%), Fiber (5.24%-10.23%), Carbohydrates (15.89% -23.12%) and Protein (12.64% -19.03%). Seeds of the bitter melon also have minerals such as potassium, calcium and magnesium. The minerals which were present in traces were iodine (3.02mg/100g - 4.92 mg/100g), zinc, iron. It has gained importance in society, due to immense nutritional properties.

Product development:

Bhansaly, (2007) resulted that the processed fruit and seeds were used to develop various products viz. sour pickle, sweet pickle, salty and sweet roasted seeds, ladoo and weaning mixtures. The mean scores of products for their organoleptic acceptability on nine point hedonic ranking scale ranged from 7.4 to 8.3 for products and 7.4 to 8.5 for Tumba seed products. Among all the preparations roasted salty seeds scored highest i.e. 8.3, whereas Tumba seed weaning mixture scored lowest i.e. 7.0 the storable products i.e. pickle, roastedseeds, ladoo and weaning mixture were studied for their shelf life in terms of sensory evaluation, free fatty acids fat acidity content at a interval of 15vdays for a period of 90 days. Results of sensory study revealed that the increase in free fatty acid and fat acidity in all the products was found to be within the safe limits and scores of the organoleptic evaluation showed that the product remained well acceptable after 3 months of storage. So it can br concluded that tumba has a great scope in field of product development.

Therapeutic value of tumba:

I) Tumba as an anti-diabetic agent:

Abdel (2000) investigated the effect of the aqueous glycosidic, alkaloidal and saponin extracts of the rind of Citrullus colocynthis on the plasma glucose level in the rabbits. Oral administration of aqueous extract (300mg/kg) produced significant reduction in plasma glucose level. Similarly, the extract of Citrullus colocynthis fruit was injected in isolated rat pancreas at islets side and studied for its insulinotropic effect by Namila *et.al.,* (2000). The result indicated that the purified extract provoked a clear dose dependent increase in insulin release, which could partially account for the antidiabetic activities of these fruits. Similarly Nabila (2009) reports that the fruit of Citrullus colocynthis is traditionally used in Mediterranean countries as infusions to treat diabetes mellitus. The present study investigates the effects of a daily intraperitoneal administration, for a period of 14 days, of extracts from Citrullus colocynthis seeds on fasting glucose level, oral glucose tolerance test, body weight, food and fluid intake in streptozotocin-induced diabetic rats. Although the intraperitoneal injection of such extracts failed to affect significantly glycemia over a period of 180 min, glucose tolerance was improved after concomitant oral administration of glucose and an aqueous extract (E1). Even when the E1 extract was applied externally for 180 min, a trend towards improvement of glucose homeostasis was noticed in the diabetic rats. After one and two weeks of daily intraperitoneal injection of the plant extracts, the glycemia

measured after overnight fasting was lower than that recorded in diabetic rats injected daily over the same period with saline. Under the same experimental conditions, the plant extracts prevented the decrease in body weight otherwise observed in the diabetic rats, despite a decrease in both fluid and food intake at the 7th and/or 14th day of these experiments. As a rule the wet weight of liver, pancreas, testis and kidneys, measured on day 15 failed to differ significantly in control and extract-treated diabetic rats. These findings thus document the beneficial long-term effects of Citrullus colocynthis seed streptozotocin-induced diabetic rats.

ii) Antimycobacterial, antiinflammatory and phytochemical activity of Citrullus colocynthis

The crude ethanolic extracts of Citrullus colocynthis were examined for their antibacterial potentialities. The extract were found to be active against gram positive Bacilli viz. Bacillus pumilus and Staphylococcus aureus (Memon *et.al*.,2003). Similarly, Yoshikawa *et.al.,(*2007)studied the inhibitory effect of Citrullus colocynthis on ear passive cutaneous anaphylaxis reaction as a type-1 allergic model in mice. The result referred that methanolic extract of two new glycoside i.e. colocynthosides A and B were exhibited the antiallergic activity at a dose of 100 and 125 mg/kg respectively. However Mehta *et.al.,* (2013) stated that Citrullus colocynthis (Cucurbitaceae), a folk herbal medicine and traditionally used natural remedy for tuberculosis in India has been studied to validate its antitubercular activity against drug sensitive and drug resistant (including multi-drug resistant) Mycobacterium tuberculosis and Mycobacterium other than tuberculosis (MOTT) bacilli. The present study provides a scientific rationale for the traditional use of C. colocynthis fruit in the treatment of tuberculosis. Three compounds C-1: ursolic acid, C-2: cucurbitacin E 2-0-β-D-glucopyranoside and C-3: cucurbitacin E 2-0-β-Dglucopyranoside were isolated, C-1 and C-2 showed good anti-tubercular activity by inhibiting 7 non-MDR, 8 MDR and 1 XDR M. tuberculosis and 2 MOTT clinical isolates. It can be stated from results of present investigations that C. colocynthis fruit can be taken up as a good and potential candidate for the development of new drug for multi-drug resistant tuberculosis and MOTT bacilli. Similarly Uma and Sekar(2014) stated that the medicinal plant part has potent bioactive compounds which could be used for therapeutic purpose and/or as precursors for the synthesis of useful drugs. It suggested that the decoctions, emulsion, apozenes or liquid extract or liniment or powders and others prepared from this medicinal plant may be very rich in nutrient composition and chemical substances, which may be of great importance to pharmaceutical companies. The phytochemical study of Citrullus colocynthis gives valuable information about the chemicals present in the plant. The behaviors of leaf powder upon treatment with different chemical reagents was also analyzed. The various qualitative chemical tests showed the presence of diterpenoids, saponin, sterols, flavonoids, carbohydrate and alkaloids. Aromatic acid, gums, mucilage and tannin were totally absent in the leaf, root, and seed of this plant.

Hussain *et.al.,*(2014) reported that In this review, we have documented the existing traditional uses of the Citrullus colocynthis fruit and summarized recent research into the phytochemistry and pharmacology of the fruit and nutritional value of seeds of Citrullus colocynthis. The extracts and isolated compounds have been found to possess various biological activities, especially in the area of antidiabetic, anticancer, anti-inflammatory, antioxidant, insecticidal and antimicrobial. Interestingly, plant has been shown to be of high nutrition value being a rich source of protein, edible quality of seed oil and some important minerals such as calcium, potassium and magnesium, known to be of high medicinal value. While Mohamed (2013) reviewed that skin, gynecological and lung infections are caused by microorganisms exist in the world. The treatment of these infections is mainly based on the use of synthetic drugs that become, in recent years, ineffective, due to the resistance of bacterial strains and the proliferation of opportunistic fungi. The aim of this study is to test *in vitro* antibacterial activity of aqueous extract from seeds of Citrullus colocynthis which was detected phytochemical families existing. These antimicrobial powers are measured using the micro-dilution method against the Gram-negative bacteria (Escherichia coli ATCC 25922 and Pseudomonas aeruginosa ATCC 27853) and Gram-positive (Enterococcus faecalis ATCC 29212 and Staphylococcus aureus ATCC 25923). The results showed that seeds of C. colocynthis are rich by bioactive substances. All tested extracts of C. colocynthis showed antimicrobial activity against all strains tested. The folk medicinal use as a broad-spectrum antimicrobial agent is validated.

Some other applications of Tumba

In 1990, American Botanical Council reported that the dried pulp of unripe Tumba fruit, free from seed constitutes the drug colocynth, which is used for acute and chronic constipation and for liver and gall bladder ailments. Similarly, Nadkarni (1998) stated that the active principle of colocynth includes a bitter amorphous alkaloids and a resin, which has a purgative action. The roots of Tumba are used to treat jaundice, urinary disease and rheumatism and its oil used to treat the snake bites, scorpion stings and bowl complaints. A nontoxic dental care herbal formula comprising fractions of Azadirachta indica, *C. colocynthis and Cucumis sativus* was innovated by Behl *et.al.,* (2006) which is found to be active against dental plaque and gingivitis.

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