

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/344457599>

A REVIEW ON AMARANTHUS TRICOLOR AS A TRADITIONAL MEDICINAL PLANT

Article in World Journal of Pharmaceutical Research · October 2019

DOI: 10.20959/wjpr201911-15781

CITATION

1

READS

226

4 authors, including:



Punet Kumar

Shri Gopichand College of Pharmacy

23 PUBLICATIONS 51 CITATIONS

[SEE PROFILE](#)



Sangam Singh

Oxford college of pharmacy hapur

13 PUBLICATIONS 31 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Coronavirus (COVID-19) [View project](#)

A REVIEW ON *AMARANTHUS TRICOLOR* AS A TRADITIONAL MEDICINAL PLANT

Vidhan Chand Bala^{1*}, Mohd. Avid², Punet Kumar³ and Sangam³

¹Department of Pharmacology, Oxford College of Pharmacy, Hapur, Utter Pradesh, India.

²Department of Pharmacology, IFTM University, Moradabad, Utter Pradesh, India.

³Department of Pharmaceutical Chemistry, Oxford College of Pharmacy, Hapur, Utter Pradesh, India.

Article Received on
12 August 2019,

Revised on 01 Sept. 2019,
Accepted on 22 Sept. 2019

DOI: 10.20959/wjpr201911-15781

*Corresponding Author

Vidhan Chand Bala

Department of
Pharmacology, Oxford
College of Pharmacy, Hapur,
Utter Pradesh, India.

ABSTRACT

The present article is based on *Amaranthus tricolor* belonging to family Amaranthaceae. *Amaranthus tricolor* is a topical annual herb with long leaves and small black seed and it can attain a height of maximum 5fits. The study is done on lives part of plant is very nutritive and it is also rich in fibers. The decoction of the root of the plant with *Cucurbita moschata* is used to control bleeding. It is also used hepatic disorder and improved the vision of eyes, the study also suggest that it has the property of inhibition of calcium retention, the leaves is also rich in Vitamin-A, B, B2, Vitamin-C and minerals like calcium, iron. From the scientific study of *Amaranthus tricolor* it is

most non to posses' Antiarthritic, Hepatoprotectis, Antinocieptive and Anti-inflammatory activity. The present article was due to evaluate in vitro anti-oxidant activity, Hematological, antibacterial and Hypolipidimic properties of *Amaranthus tricolor*.

KEY WORDS: *Amaranthus tricolor*, nutritive, *Cucurbita moschata*, haemorrhage, minerals, calcium, iron.

INTRODUCTION

Amaranthus tricolor L. belonging to the Amaranthaceae family is a decorative plant known as Tandalijo or Tandalja bhaji in India. The synonym for A. tricolor is A. gangeticus. In Andhra, it is commonly called "Perugu thotakura". The leaves are very nutritious. The nutrients in the leaves include carbohydrates, proteins, vitamin A, vitamin C, riboflavin (vitamin B2), thiamine (vitamin B1), niacin and minerals such as calcium and iron. It is also a

source of fiber. Due to its high nutritional value, *A. tricolor* is consumed more than other leafy vegetables.

The whole plant is traditionally used as an astringent (Chopra *et al.*, 1956). The root decoctions of *A. tricolor* and *Cucurbita moschata* are used to prevent bleeding after an abortion (Duke and Ayensu, 1985). The decoction of the plant is taken internally to strengthen the liver and improve vision. A scientific study on the plant suggests that it could inhibit calcium retention (Larsen *et al.*, 2007).

It has been scientifically reported that the plant has antioxidant (Samsul *et al.*, 2013), hepatoprotective (Simran *et al.*, 2013), antinociceptive and anti-inflammatory activities (Gopal *et al.*, 2013). *In vitro* and *in vivo* anticancer effects have also been reported (Sani *et al.*, 2009) and antioxidant, anti-amylase, antiarthritic and cytotoxic activity *in vitro* (Vivek Kumar *et al.*, 2011). The presence of betalaine-based pigments, such as amaranth, betaxanthin, a methyl derivative of arginine, betaxanthin and betalamic acid, has been reported in the leaves (Mousumi *et al.*, 2013).

Herbal formulations have been used for many years not only in Asian countries but also worldwide for the well-being of humans. Herbal formulations claimed to improve physical endurance; mental functions and nonspecific body resistance have been called adaptogens (Saggu *et al.*, 2007). The potential usefulness of expensive herbal medications as anti-stress agents has been reported, since they can resist stress without altering the physiological functions of the body. Different herbs such as *Withania Somnifera*, *Emblica officinalis*, *Asparagus racemosus*, *Ocimum sanctum*, *Tribulus terrestris* and *Piper longum* have immunomodulatory, adaptogenic and anabolic effects and the ability to improve vital energy (Naik *et al.*, 2006).

PLANT PROFILE: *Amaranthus tricolor*

Scientific classification

Order: Caryophyllales
Family: Amaranthaceae
Subfamily: Amaranthoideae
Genus: *Amaranthus*

Common name: Lal saag, Tembdi bhaji, Amaranth, Chainese spinach, Pigweed.

Vernacular Names

Assamese:	Bishalya karani, Bishalya.
Bangali:	Dengua.
Hindi:	Lal saag, Chaulai.
Kannada:	Dantana soppu, Chikka harive soppu.
Marathi:	Chavalaayi, Ranmauth.
Oriya:	Bajjisag
Sanskrit:	Alpamarisa, Marsha,
Tamil:	Thandkkeeral, Cherikkiral
Telugu:	Thokakooru.
Malayalam:	Cheera, Chenjeera.



Fig: Amaranthus tricolor.

Geographical Distribution and Habitat

The genus *Amaranthus* has a global distribution and is more abundant in the tropics. It is not abundant in countries with cold weather. It is believed that tricolor amaranth, the main type of vegetable, is native to South or Southeast Asia (Grubhen and Sloten 1981). From there, it was curry and spread in the tropics and the temperate zone (Martin and Telek, 1979). by emigrant.

It is the most widespread species, commonly cultivated in India, Indonesia and the Pacific Islands in Papua New Guinea, northern Japan, northern China and western Africa. It has been introduced more often by Asians in other parts of the world, for example. in the United States It could also have escaped like an herb. Many species of amaranth are grown as vegetables in

the tropics and East Asia (Feine de at., 1979). Only with the tricolor, extensive cultivation has been cultivated, mainly in southern China (Martin and Ruberte, 1979).

DESCRIPTION

Amaranthus tricolor is an annual tropical harem, with long leaves and small black seeds, up to a maximum height of 5 feet. The leaves are elliptical in the form of a spear or red and can grow up to 5 inches long. The leaves are annotated or rounded at the ends. The flower clusters are axillary. Often spherical or slightly spherical and with a closed terminal tip, but occasionally, the terminal tip is well developed. There are three sepals. The fruit is dehiscent with a lid in dehiscence. The seeds are black and small with approximately 1200-2900 seeds / gram. It is a short-lived quantitative plant, which is an advantage in the subtropics where the generation stage is delayed during the summer. Due to the rapid growth, water consumption is high. The crop normally uses about 6 mm / day and prefers fertile, well drained soils with a loose structure. The absorption of minerals is very high.

PHYTOCHEMICAL CONSTITUENTS

Amaranthus tricolor is a rich source of protein, essential for the growth and development of any living organism. The plant is also a rich source of B-carotene, zeaxanthin, lutein, violaxanthin-neoxanthin / will and Ranga, 1996). It is rich in minerals (calcium, iron, BC, vitamin C, Riboflavin and folate) (Shukla et al., 2006, Rao et al., 2010, Jerz et al., 2007). Two isolated chlorophyll degradation products [32-hydroxy- (132-5) -phytyl-a and chlorophyll-methoxylactone by high-speed countercurrent preparative chromatography from lipophilic extracts of the aerial part of *A. tricolor*.

The main unsaturated fatty acids found in *A. tricolor* are lactic acid in the seeds (49%), water vapor (46%) and linolenic acid in the leaves (42%), while the main acid Saturated fats in seeds, water vapor and leaves are palmitic acid in 18-20% of total fatty acids (Feranando and Bean-1984). The mature leaves of *A. Tricolor* contain red-violet, bethocyanin, amaranth and iso-caramantine pigments (Piatell, et al., 1969). Present in the plant (Rao et al., 2010) Vitamins C and A are present in nutritionally significant amounts, with an average of 420 ppm of vitamin C and 250 ppm of B-carotene (will et al., 1984). It has not been possible to conclude that vitamin B-12 is similar in activity (Janhar et al., 1974). Minerals such as potassium, iron, magnesium and calcium (Table 6) also exist in significant concentrations, with average values of 287 ppm of iron and 2.1% of calcium (dry matter). The presence of large amounts of oxalate (s) ranges from 0.2 to 11.4% (dry weight). You can limit the

availability of these nutrients. It also contains large amounts of essential proteins and amino acids, such as lysine (De Macrean et poli, 2002).

TRADITIONAL USES

Amaranthus tricolor is consumed daily as sautéed, soup, curry or salad and has a delicious and slightly sweet taste. Goa specialties made with this leafy vegetable include steamed leaves with grated coconut, or with jaca or dal fruit seeds. It is also consumed in the form of soup. It is usually cooked in the same way as spinach. The leaves and softer parts of the shoots are usually boiled in various waters and then separated from the cooking liquid (Martin and Talek, 1979), through which we have traditionally steamed in Uganda (Stafford et al., 1976). In Nigeria (Okiei and Adamson, 1979), three-color leaves are combined with condiments to make soup, used in salads, boiled and mixed with peanut sauce in Mozambique (Oliveria and de Carvalho, 1975) or ground and ground. grind Served in sauce (floury). vegetables in West Africa (Martin and Telek, 1979).

The flavor of raw and cooked vegetable amaranth was equal to or greater than that of spinach or any other similar green (Martin and Ruberte 1979, Daloz 1980, AbboH and Campbell 1982).

Chinese spinach (*A. tricolor*) is usually treated with heat (Keshinro and Ketiku 1979, Wills et al. 1984). Typical processes include cooking, steaming, bleaching, frying and baking (Ajayi and Osibanjo, 1980, Oko, 1983, Saunders and Beciker, 1984, Stafford and Elral, 1976, Bassir and Faunso, 1975).

Singh et al. (2009) reported that products such as biscuits, mathi, motar and sev enriched with *Amaranthus tricolor* leaf powder had significantly higher levels of protein, fat, ash and fiber than their counterparts. witnesses The consumption of these value-added products would help to improve the nutritional status of the population, particularly the vulnerable part.

THEAPEUTIC USES

Amaran, therefore, tricolor has a variety of medicinal values. A study of popular literature has revealed the following statements: some of which have been practiced to this day. Goa folklore suggests that the plant is very nutritious, especially for validation patents and anemia. Consumed as a liver tonic, the plant also has a cooling effect on the body and its

consumption is recommended during the summer months due to its diaphoretic nature. It is highly recommended as a medicinal food for babies, mothers and anomic patients.

The leaves and stem are purgative in nature and are used in poultices (fresh or dry powder) to treat inflammation, boils and abscesses, gonorrhoea, orchitis and hemorrhoids. It is said to prevent calcium retention. It is also used as a diuretic and in the treatment of bladder disorders. The entire plant is astringent in nature (Chopra et al., 1956) and a root decoction with *eueurbiter mosehata* would be used to control bleeding after abortion (Duke and Ayensu, 1985). A decoction of very old plants is taken internally to improve vision and strengthen the liver. Its use as ampelmine has been mentioned in some places. The decoction of this plant is highly recommended for menorrhagia. It has also been found beneficial in cases of diarrhea, dysentery and intestinal bleeding. It has also been used as a topical application in ulceration of the mouth and throat, in leukorrhoea and as a washing solution for indolent and disgusting ulcers (Chopra et al., 1956).

However, it is hardly used today.

The fruits of *Amaranthus tricolor* are chewed by the tribes to cure colds and cough (Rai and Nath, 2003). The roots of *A. tricolor* are useful in dysentery. Due to its fibrous nature, it facilitates digestion and corrects constipation. It is said to purify the blood after childbirth, strengthen hair roots and increase blood values. In some areas, a pure leaf is applied to poisonous animal bite wounds (Buragohain, 2011). The leaves are believed to have febrifugal properties. The tribes of the Chhattisgarh district claim that the daily consumption of this plant contributes to weight loss and regulates menstrual disorders.

He is well known for treating a variety of ailments, such as throat infections, toothache, eczema, gonorrhoea, leukorrhoea and impotence. Botanically, plants are used as a blood purifier, tonic as dropsy, as ascaricide, earache, sore throat and bronchitis. The root, leaves and stems are consumed in a bilious state. Roots and seeds are used in impotence agents such as colic, gonorrhoea, eczema and have galactogenic properties. Decoction of *A. tricolor* roots with *Cucurbita pepo* Linn. It is used to control bleeding after an abortion. The roots are considered softeners and constitute the form of decoction used for hemorrhoids and diarrhea in children (Kirtikar and Basu, 2003).

In previous texts, *Amaranthus tricolor* is also called *Amaranthus gangeticus* var. *melancholicus*, which refers to the history of the medical use of the plant in the treatment of

chronic disorders. In Ayurveda, the plant is said to relieve vata, pitta, constipation, urinary retention, edema, reduced vision, manorrhagia, leucorrhoea, as well as stimulant and tonic for general weakness.

A review of the available literature reveals that *Amaranthus tricolor* has liver cirrhosis caused by carbon tetrachloride in hepatoprotection (Al-Dosari, 2010). An antiviral protein that confers a high resistance to the hemp rosette virus has been purified from the dried leaves of *A. tricolor* (Roy et al., 2006).

Ayurvedic properties of *Amaranthus tricolor*

Rasa: Kashava. Madhura

Guna: Guru, Snigdha

Virya: Seeta

Other Uses

In many areas, *A. tricolor* is used as fodder or as an ornamental plant. The red dye obtained from the natural leaves of *A. tricolor* is used to color alcoholic beverages in Bolivia and the northwest to color the corn pulp in Mexico and the southwest of the United States (Saure, 1980), as well as for the dyeing of food and drinks in Ecuador (Fain and Hauptli, 1980). The dye is derived from violet red pigments such as amaranth betocyanins and isoamarantine (Piatelli et al, 1969). The use of dye seems limited to non-amaranth crops as a cereal crop (Sauer, 1950). Yellow and green dyes can also be obtained from the entire plant (Grae, 1974).

PHARMACOLOGICAL ACTIVITY

Evaluation of *in-vitro* antioxidant activity

To evaluate the antioxidant activity of various extracts of *Amaranthus tricolor* Linn leaves. The leaves of *Amaranthus tricolor*. L, dried in the shade, are extracted with ethanol (95%) and then divided into petroleum ether, chloroform and ethyl acetate. The antioxidant activity of several extracts of *Amaranthus tricolor* leaves is evaluated in vitro by the free radical removal activity (DPPH method) and by the determination of nitric oxide removal activity. Ascorbic acid is used as a reference standard (Samsul alam et al., 2013).

Evaluation of the Hematological, Hypoglycemic, Hypolipidemic Properties *Amaranthus Tricolor* Leaf

Objective: To study the proposal of the *Amaranthus tricolor* leaf extract on certain biochemical parameters in the diabetic rat and the normal rat.

Methods: the antioxidant properties of the aqueous extract of A. The tricolors were analyzed using decreasing ferric plasma potency (FRAP) assay, a 2, 2-diphenyl-1-picrylhydrazyl (DPPH) assay and a phosphomolybdenum assay. The effect of leaf extract on glucose and serum triglycerides, total cholesterol, low density lipoprotein (LDL), very low density lipoprotein (VLDL), high levels of high density lipoprotein (HDL), and hematological parameters were evaluated in diabetic and normal rats. The extract doses used were 200 and 400 mg / kg body weight. Acute toxicity studies were also performed (A Colaco e Clemente and PV Desai, 2011).

Antiarthritic activity

The objective of the study was to evaluate the antiarthritic activity of the hydroalcoholic extract of *Amaranthus tricolor* L. (HAEAT) in Freund's complete adjuvant arthritis (FCA) in female Wistar rats. HAEAT was prepared by maceration and underwent a preliminary phytochemical examination and tested against FCA-induced arthritis in the rat. The arthritis evaluation was performed by measuring the leg volume, joint diameter, body weight, arthritis score, pain threshold, thermal hyperalgesia, hematological and biochemical parameters. (Gopai, V. Bihani et al., 2015).

Antibacterial activity of *Amaranthus tricolor* (L)

The infections of the urinary tract (ITU) are the most common bacterial infecciones, that mantiene to the personas that viven toda su vida. The propuesta of this study is to evaluate the antibacterial activity of the amaranto extract of amaranto and to determine the clinical characteristics of the infections of the urinary tract. In this studio, the extract of hoja A. tricolor prepared for the maceration in frío con metanol. The prediction of metamorfosis preconceida of the presence of carbohydrates, amino acids, proteines, steroids, alkaloids, glucosides, flavonoids and tanninos. In this study, agents of the urinary tract, Staphylococcus saprophyticus, Enterococcus faecalis, Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae and Proteus vulgaris are used. Determinado el antibacteriano propionad mediando el metodo difusión de pocillos de agar, determinó the concentration inhibitoria

mínima (MIC) para el eléctrico eléctrico de las hojas A. Crudo tricolor por el método de ensayo de placa de microtitulación de resazurina (Sowjanya Pulipati y al ., 2015).

CONCLUSION

In this review, we obtained information on the morphological characteristics of *Amaranthus tricolor*. The decoction of the root of the plant to Cucurbita moschata is used for the control of hemorrhages; It is also used for liver problems and improves eyesight. The study also suggests that it has the property of inhibiting calcium retention, the leaves are also rich in vitamin A., B, B2, vitamin C and minerals such as calcium, iron. According to the scientific study of *Amaranthus tricolor*, it is extremely harmless to possess an anti-arthritic, hepatoprotective, anti-inflammatory and anti-inflammatory activity.

ACKNOWLEDGEMENT

We are thankful to School of Pharmaceutical Science, IFTM University to providing all the necessary facilities like internet and books available in the college library to do work. All the authors have no conflict of interest.

REFERENCES

1. A colaco clement and P.V. desai evaluation of the hematological, hypoglycemic, hypolipidemic and antioxidant properties of *amaranthus tricolor* leaf extract in rat. tropical journal of pharmaceutical research., 2011; 10(5): 595-602.
2. Abbott, J.A. & Campbell, T.A. Sensory evaluation of vegetable amaranth (spp.). Hort Science 17, Amaranthus, 1982; 409.
3. Ajayi, S.O. & Osibanjo, O. Vitamin C losses in cooked fresh leafy vegetables. Food Chem., 1980; 5: 243.
4. Al-Dosari M.S. The effectiveness ethanolic extract of *Amaranthus tricolor* L. A natural hepatoprotective agents. Am J chin Meb., 2010; 38(6): 1051-1064.
5. Bassir, O, & Fafunso, M. Variations in the protein, carbohydrate, lipid and ash content of six tropical vegetab les. Plant Foods for Man, 1975; 1: 209.
6. Buragohain J. Ethanimedical Plants Used by the ethanolic Communités of Tinsukia District of Assam, India. Rec Rec Sci Technol, 2011; 3(9): 31-42.
7. Chopra R.N. Nayar S.L. Chopra I.C. Glossary of Indian Medicinal Plants. New Delhi: Councile of Scintific and Industerial Reserch (CSIR), 1956; 15-18.
8. Chopra R.N. Nayar S.L. Chopra I.C. Glossary of Indian Medicinal Plants. New Delhi: Councile of Scintific and Industerial Reserch (CSIR), 1956; 15-18.

9. Daloz, C. Amaranth as a leaf vegetable: Horticultural observations in a temperate climate. In "Proceedings of the Second Amaranth Conference," 1980; 68. Rodale Press, Emmaus, PA.
10. De Macvean, A.L.E., & Pöll. Chapter 8: Ethnobotany. J. A. Vozzo, Tropical Tree Seed Manual. Washington, D.C., U.S. Dept. of Agriculture, Forest Service, 2002. OCLC 51763 101.
11. Duke J.A. & Ayensu E.S. Medicinal Plant of China. Strichzeichnungen. Reference publication. Inc, Algonac. Michigan, 1985; 2: 705 S.1300.
12. Feine, L.B., Harwood, R.R., Kauffman, C.S., & Senft, J.P. Amaranth: Gentle giant of the past and future. In "New Agricultural Crops," ed. G.A. Ritchie, 1979; 41. Westview Press, Boulder, CO, 1979.
13. Fernando, T. & Bean, G. Fatty acids and sterols of *Amaranthus tricolor* L. Food Chem., 1984; 15: 233-237.
14. Gopal V. Bihani, Parag P. Kadam, Subhash L. Bodhankar. Antiarthritic activity of hydroalcoholic extract of leaves of *Amaranthus tricolor* in Freund's complete adjuvant-induced arthritis in wistar rats. World journal of pharmaceutical research, 2015; 4(4): 1337-1354, 2277-7105.
15. Grubben, G.J.H., & Van Stolen, D.H. Genetic resources and Amaranths, Intl. Board for Plant Genetic Resources, Food and Agriculture Organization, Rome, 1981; 45.
16. Jerz, G., Arrey, T.N., Wray, V., Du, Q., & Winterhalter, P. Structural characterization of 132 hydroxy-(132-S) phaeophytin-a from leaves and stems of *Amaranthus tricolor* isolated by high-speed countercurrent chromatography. Innovat Food Sci Emerg Tech, 2007; 8(3): 413-418.
17. Kartikar K.R. & Basu B.D. Indian Medicinal Plants. International Book Distribution, Dehradun, Edition, 2003; 9(III): 2832-2840.
18. Martin, F.W. & Telek, L. Vegetables for the hot humid tropics. Part 6: Amaranth and Celosia. U.S. Dept of Agric., New Orleans, LA., 1979.
19. Martin, F.W., & Rube rte, R.M. Edible leaves of the tropics. U.S. Dept. of Agriculture, Mayaguez Inst. of Tropical Agriculture, Mayaguez, Puerto Rico., 1979.
20. Oke, O.L. Amaranth. In "Handbook of Tropical Foods," ed. H.T. Chan Jr., p. 1. Marcel-Dekker, Inc., New York., 1983.
21. Okiei, W., & Adamson, I. Nitratenitrite, vitamin C and in-vitro methemoglobin formation from some vegetables. Nutr Rep Intl, 1979; 19: 241.

22. Oliveira, J.S. & de Carvalho, M.F. Nutritional value of some edible leaves used in Mozambique. *Econ Bot*, 1975; 29: 255.
23. Piatelli, M., Denicola, M., and Castrogiovanni, V. Photocontrol of amaranthin synthesis in *Amaranthus tricolor*. *Phytochem*, 1969; 8: 731.
24. Rai R. & Nath V. Use of medicinal plants by traditional herbal healers in central India. Paper presented at XIIth World Forestry Congress, Quebec City, Canada, 2003.
25. Rao, K.N.V., Padhy, S.K., Dinakaran, S.K., Banji, D., Madireddy, S., & Avasarala, H. Study of pharmacognostic, phytochemical, antimicrobial and antioxidant activities of *Amaranthus tricolor* linn. leaves extract. *Iranian J Pharm Sci.*, 2010; 6(4): 289-299.
26. Rao, K.N.V., Padhy, S.K., Dinakaran, S.K., Banji, D., Madireddy, S., & Avasarala, H. Study of pharmacognostic, phytochemical, antimicrobial and antioxidant activities of *Amaranthus tricolor* linn. leaves extract. *Iranian J Pharm Sci.*, 2010; 6(4): 289-299.
27. Roy S, Sadhana p, Begum m, Kumar S, Lodha ML, & Kapoor H.C. Purification, Characterization and cloning of antiviral/ribosome inactivating protein from *Amaranthus* leaves. *Phytochem*, 2006; 67(17): 1865-1867.
28. Samsul alam, krupanidhi k, k.r.s sambasiva rao evaluation of *in-vitro* antioxidant activity of *Amaranthus tricolor* linn. *asian journal of pharmacology and toxicology*, 2013; 01(01): 2013, 12-16.
29. Saunders, R.M. & Beciker, R. *Amaranthus*: A potential food and feed resource. In "Adv. Cereal Sci. Technol," Am Assn Cereal Chemists, St. Paul, MN, Vol. VI, ed. Y. Pomeranz, 1984; 357.
30. Shukla, S., Bhargava, A., Chatterjee, A., Srivastava, J., Singh, N., & Singh, S.P. Mineral profile and variability in vegetable Amaranth (*Amaranthus tricolor*). *Plant Food Hum Nutr*, 61: 21-26.
31. Singh S. Punia D. & Khetarpaul N. (2009). Nutrient composition of products prepared by incorporating amaranth (*Amaranthus tricolor*) leaf powder. *Nutr Food Sci.*, 2006; 39(3): 218-226.
32. Sowjanya Pulipati, Srinivasa Babu P, and Lakshmi Narasu M. Phytochemical analysis and antibacterial efficacy of *Amaranthus tricolor* (L) methanolic leaf extract against clinical isolates of urinary tract pathogens. *African Journal of Microbiology Research*, 2015; 9(20): 1381-1385.
33. Stafford, W.L., Mugerwa, J.S., & Bwabye R. Effects of methods of cooking, application of nitrogen fertilizers and maturity on certain nutrients in the leaves of *Amaranthus hybridus* subspecies *hybridus* (Green Head). *Plant Foods for Man*, 1976; 2: 7.

34. Stafford, W.L., Mugerwa, J.S., & Bwabye R. Effects of methods of cooking, application of nitrogen fertilizers and maturity on certain nutrients in the leaves of *Amaranthus hybridus* subspecies *hybridus* (Green Head). *Plant Foods for Man*, 1976; 2: 7.
35. Wills, R.B.H., & Ranga, A. Determination of carotenoids in Chinese vegetables. *Food Chem.*, 1996; 56: 451–455.
36. Wills, R.B.H., Wong, A.W.K., Scriven, F.M., & Greenfield, H. Nutrient composition of Chinese vegetables. *J Agric Food Chem.*, 1984; 32: 413.
37. Wills, R.B.H., Wong, A.W.K., Scriven, F.M., & Greenfield, H. Nutrient composition of Chinese vegetables. *J Agric Food Chem.*, 1984; 32: 413.