

# Antioxidant Activity of *Amaranthus Viridis* Linn

Omkar R. Zaware<sup>1</sup>, Rutika S. Wakchaure<sup>2</sup>, Akshada V. Tambe<sup>3</sup>, Rahul P. Lokhande<sup>4</sup>

Bachelor of Pharmacy, Samarth Institute of Pharmacy, Belhe, Pune, Maharashtra, India<sup>1,2,3</sup>

Department of Pharmaceutical Chemistry, Samarth Institute of Pharmacy, Belhe, Maharashtra, Pune, India<sup>4</sup>

**Abstract:** *Amaranthus viridis* L. belongs to family (Amaranthaceae). It is a common wild vegetable and weed of cultivation. Phytochemistry and antioxidant activity of *Amaranthus viridis* Linn. (Green leaf) were undertaken with standard methods. The phenolic and flavonoids compounds identified in leafy vegetable *Amaranthus viridis* demand a comprehensive pharmacological study. *Amaranthus viridis* contains several compounds like arginine, amino acids lysine, histidine, cystine, valine, phenylalanine, leucine, isoleucine, tyrosine, threonine, methionine, etc. In search of new activities pytochemical screening, chemical entities of the *Amaranthus viridis* extract from leaves, indicates the presence of biologically active constituents like tannins and phenols, saponins, alkaloids, flavonoids, cardiac glycoside, steroid and triterpenoids. *Amaranthus viridis* contains some chemical constituent that possesses potent anti-inflammatory, antiviral, antihepatotoxic, antiulcer antiallergic actions. *Amaranthus viridis* is used in Indian traditional system to reduce labour pain and act an anti-inflammatory and santipyretic. Other traditional uses range from an anti-inflammatory agent of the urinary tract, anti-rheumatic, antiulcer, venereal diseases vermifuge, diuretic, anti-rheumatic, antiulcer, analgesic, antiemetic, laxative, , antileprotic, improvement of appetite, treatment of eye problems and respiratory problems , to treatment of asthma. Also the phenolic and flavonoids compounds identified in leafy vegetable *Amaranthus viridis* demand a comprehensive pharmacological study.

**Keywords:** *Amaranthus viridis*, Pharmacologicals, Pytochemicals, Anti-inflammatory, Antinociceptive, Antidiabetic, Hepatoprotective, Antihyperglycemic, Antihyperlipidemic, Cardio Protective

## I. INTRODUCTION

*Amaranthus viridis* is known as Slender Amaranthus. It is a fast-growing strong, straight, branched plant, an annual plant that grows 10 - 100cm tall. *A. viridis* belongs to the Amaranthaceae tribe. This plant is often harvested in the wild as a source of food and medicine for local use. It is grown in Latin America, Asia and Africa. *Amaranthus viridis* abounds everywhere in all temperate regions of the world. It is one of the most common weeds in tropical, subtropical climates and warmer regions. It is listed on almost all the world's warmest and hottest flowers. *Amaranthus viridis* is found in almost all disturbed habitats. It grows in heavy, sandy loam soils, including muddy soil after the water recedes during the growing season. *Amaranthus viridis* represents one of the richest sources of medicinal properties and natural phenolic compounds. Amaranth also contains several pigments, such as carotenoids, chlorophyll, amaranthine, anthocyanins, beta lain, beta xanthine, and betacyanins as well as natural antioxidant phytochemicals, such as vitamin C, beta carotene, flavonoids, and phenolic acids, which act as types of active oxygen (ROS) scavengers in the human body. The active nitrogen species produced by oxidation have been shown to be linked to a variety of degenerative disorders such as aging, cancer, osteoporosis, inflammation, and cardiovascular problems. Phenolic compounds represent one of the important families of antioxidants due to their free radical scavenging activity showed the promising pharmacological properties in several in vitro model systems by total reduction capability, DPPH and ABTS free radical scavenging activity, and metal chelating activity. The primary objective of the present study was to examine phenolic compounds, an antioxidant of pure and aqueous methanol extract components from seeds and leaves of locally grown *Amaranthus viridis* plants to explore their potential pharmaceutical and functional food uses. Most of the research on *Amaranthus viridis* has indicated that it has folkloric uses for the treatment of inflammation, ulcer, and asthma, hyperlipidemic, diuretic, rheumatic, and analgesic. In our earlier report, we have characterized and identified phenolic compounds present in *Amaranthus viridis* using ultra performance liquid chromatography-tandem mass spectrometer. To the best of our knowledge, limited studies have been reported on the chemical characterization of different fractions and antioxidant activities of *Amaranthus viridis* plants from northeast region. Therefore, this current study was designed to investigate the antioxidant, anti-inflammatory,

antidiabetic, antihyperglycemic, antipyretic, antityrosinase, and anticancer and antigenotoxicity potential of *Amaranthus viridis* extracts and their phytochemical properties.



Fig. 1: Amaranthus Viridis Plant

## II. Pharmacological Activities

### Antiphytopathogenic Activity *Amaranthus viridis*

The leaves of *Amaranthus viridis* was evaluated for antiphytopathogenic property against microorganisms resistant to the antibiotics and pesticides. This study presents the antifungal activity on fusariosis by *Piper nigrum* and Anthracnose by *Musa sp.* The organic extracts of leaves were prepared using ethyl acetate, hexane, dichloromethane, and ethanol. The extracts yields are 2.2, 2.4, 3.2 and 3.6% respectively. The minimum inhibitory concentration of *Amaranthus viridis* extracts was determined through microdilution technique using 96 well microplates. The dichloromethane, ethyl acetate and ethanol extracts exhibited MIC ranged from 15.6 a 250  $\mu$ g/ml against *Colletotrichum musae*. The ethyl acetate, hexane and ethanolic extracts showed activity against *Fusarium solani* with MIC ranging from 31.2 a 250  $\mu$ g/ml. This study revealed the presence of antifungal agents in extracts of *Amaranthus viridis*.

### Hepatoprotective Activity *Amaranthus viridis*

The hepatoprotective activity of methanolic extract whole plant of *Amaranthus viridis* were evaluated against paracetamol induced hepatotoxicity in the rats. The Wistar rats were administered for 15 days at a dose of 200 and 400 mg/kg. The hepatotoxicity showed significant increase in the levels of serum glutamate oxaloacetate transaminase, serum glutamate pyruvate transaminase, albumin and decrease in total bilirubin and protein. The rats were treated with 200-400 mg/kg dose of methanolic extract. The histopathological studies proved the hepatoprotective activity. It also showed promising decrease in the liver marker enzymes (SGOT, SGPT), bilirubin also restores the albumin and total protein levels. In vivo antioxidant studies in paracetamol given rats showed equivalent increase in lipid peroxidation and decrease in glutathione, catalase and total thiol levels.

### Anthelmintic Activity of *Amaranthus viridis*

*Amaranthus viridis* belongs to Amaranthaceae family. They are traditionally used as vermicides. The methanolic extracts of the plant was investigated for anthelmintic activity using earthworms (*Pheretima posthuma*). The activity was estimated at different concentration (10, 20, 40, 60, 80, 100 mg/ml) in dose dependent manner and compared with reference standard piperazine. The effect is due to the presence of polyphenolic compounds. All the methanol extracts were more effective in causing paralysis and death of the worms.

#### **Anti-inflammatory Effects of *Amaranthus viridis***

The experiment was carried out to investigate the anti-inflammatory activity of petroleum ether, alcoholic and aqueous extracts of *Amaranthus viridis* leaves using experimental animal models (Male albino rats, weighing 150-200g). The Anti-inflammatory property of the various extracts was studied based on their effects on carrageen induced paw oedema method and cotton pellet glaucoma in the rats. The extracts in dose levels of 50,100 and 200 mg/kg orally applied for anti-inflammatory studies.

#### **Antifungal Activity of *Amaranthus viridis***

The plants have investigated in the search for new substances against microorganisms resistant to current pesticides and antibiotics. They are evaluating the existence of antiphytopathogenic properties of organic extracts from the leaves of *Amaranthus viridis*, Amaranthaceae, popularly known as caruru. The hexanic, dichloromethanic, ethylic acetate and ethanolic extracts were obtained, respectively with yields of 2.2, 2.4, 3.2 and 3.6% (m/m). These extracts were used to determine the Minimum Inhibitory Concentration (MIC), through dilution technique using 96 well microplates. After investigating the CIM in wells where no fungal growth was detected, the Minimum Fungicidal Concentration (MFC) was determined on plates containing dextrose Sabouraud agar. The experimental crude extracts of *Amaranthus* indicate activity against the fungi *Colletotrichum musae* (Berk. and Curt), Arx, causing anthracnose of banana and against *Fusarium solani* f. sp. *piperis* responsible for fusariosis in black pepper. In comparison to *Colletotrichum musae* extracts obtained with ethyl acetate, dichloromethane and ethanol, the MIC differs from 15.6-250.0  $\mu\text{g mL}^{-1}$ . The ethylic acetate, hexanic and ethanolic extracts showed activity against *Fusarium solani* with MIC limited from 31.2-250.0  $\mu\text{g mL}^{-1}$ . In this research, it was showed the presence of antifungal constituents in extracts of *Amaranthus viridis*, revealing its potential antimicrobial effect against these two phytopathogenic strains tested.

#### **Antioxidant Activity of *Amaranthus viridis***

*Amaranthus viridis* showed the promising pharmacological properties in several *in vitro* model systems by total reduction capability, DPPH and ABTS free radical scavenging activity, and metal chelating activity. In addition, no radical scavenging activity. In addition, the results of the present study revealed the presence of strong phenolic antioxidant components mainly gallic acid, kaempferol, and chlorogenic acid in *Amaranthus viridis* extract as evidenced from UPLC-MS/MS. The current study reveals that the plant extracts have excellent pharmacological properties. Further studies are needed to identify and isolate the bioactive compounds present in the evaluated plant species; further, experiment on *in vivo* animal model will be highlighted for the treatment of oxidative stress-related disease. Thus, these *Amaranthus viridis* leaf extracts might be utilized as natural agents in pharmaceutical and food industries.

#### **Antihyperlipidemic and Antidiabetic Activities of *Amaranthus viridis***

To investigate the hypolipidemic and antihyperglycemic effects of methanolic extract of leaves of *Amaranthus viridis* (MEAV) in normal and Streptozotocin (STZ) induced diabetic rats. The activities of methanol extract of leaves of *Amaranthus viridis* was evaluated by using normal and STZ induced diabetic rats at dose of 200 mg/kg and 400 mg/kg by mouth per day for 21 days. Body weight and blood glucose levels were monitored at specific intervals, and different biochemical parameters such as serum triglyceride, serum cholesterol high density lipoprotein, and low density lipoprotein were assessed. Very low density lipoprotein, were also evaluated in the experimental animals. Histology of pancreas was performed. The statistical data demonstrated a significant increase in the body weight, decrease in the serum triglycerides, total cholesterol and blood glucose after treatment with MEAV. High density lipoprotein (HDL) cholesterol level was significantly increased when treated with extract.

In histological study, focal necrosis was found in the diabetic rat pancreas; however, was less profound in treated groups. The MEAV has advantageous impact in reducing the elevated blood glucose level and body weight changes, and in STZ induced rats, the lipid profile is improved. According to the International Diabetes federation (IDF), at present Type-2 diabetes affects 246 million people worldwide and is expected to increase to 380 million by 2025. Metabolic syndrome is an amalgamation of various disorders, including reduced glucose tolerance, abdominal obesity, high cholesterol and high blood pressure which enhance the risk of diabetes and cardiovascular disease. Recent studies have demonstrated a variety of important literature indicates that there is no scientific evidence to support the antihyperglycemic and

hypolipidemic effects of *A. viridis*. The present study investigates the action of methanolic extract of *Amaranthus viridis* (MEAV) in the different models of rats to ascertain the scientific basis for the use of this plant in the treatment of diabetes and hyperlipidemia.

#### **Anticancer Activity of *Amaranthus viridis***

Cytotoxic effect of all selected plant extract was assessed by using MTT assay against MCF-7, A549 and HeLa cell lines. Among the selected plant, effective cytotoxicity was shown by AVF methanol extracts on MCF-7 cancer cell line. AVF was found to show only 48.13% inhibition of MCF-7 cells at 100µg/ml concentration. Moreover, remaining plant extract showed no significant cytotoxic effect on MCF-7, A549 and HeLa cell lines. *Amaranthus viridis* exhibited significant percentage inhibition of MCF-7 cancer cell lines. The results obtained support that additional studies may be required to isolate bioactive compounds present in plant extracts that are responsible for antioxidant and anticancer activities

#### **Qualitative Phytochemical Analysis**

*Amaranthus viridis* leave extracts were screened for the presence of secondary metabolites such as flavonoids, alkaloids, saponins, steroids, cardiac glycosides, phenolics, and tannins as described by previous method.

#### **Tannin testing**

The method was used to test for tannins. Two milliliters (2 ml) of the extract is mixed with an equal volume of bromine water. The formation of green to red rain is considered to be a positive effect of the presence of tannins.

#### **Examination of phlobatannins**

The method is used for the phytochemical testing of phlobatannins. Five milliliters (5 ml) of the extract was added to 2.0 mL of 1% Hydrochloric acid (HCl), and the red rain became evidence of the presence of phlobotannins.

#### **Testing for saponins**

The method was used to test saponins. Two drops of olive oil soaked in 1 ml of extract and stirred vigorously. The formation of emulsion was considered a positive effect of saponins.

#### **Examination of flavonoids**

The method was used to test flavonoids. One milliliter of extraction was mixed with an equal volume of sodium hydroxide (NaOH) and stirred well. The composition of the rain is considered to be a positive effect of flavonoids.

#### **Testing of alkaloids**

The method was used to test alkaloids. One milliliter of extraction was diluted with 5 ml of 2% hydrochloric acid in the steam bath and filtered. The filtrate was then treated with Meyer's reagent. Cream-colored rain was considered a positive effect on alkaloids.

#### **The Salkowski**

Steroid test was used to test the periods. 1 ml of extract was dissolved in 2.0 mL of chloroform in a test tube. On one side of the test tube, 1 ml of concentrated H<sub>2</sub>SO<sub>4</sub> was carefully added. The reddish-brown colour at the interphase was considered a good test nucleus of the steroid.

#### **Terpenoids testing**

One gram of seed sample was stirred in a test tube containing 10 ml of methanol, and then filtered. A 5 ml solution was then mixed with 2 ml of chloroform and 3 ml of sulfuric acid. The formation of a reddish-brown colour indicates the presence of terpenoids in selected plants.

#### **Cardiac glycosides**

Half a gram of the sample is dispersed in 1.0 ml of pyridine. 5 drops of 2% sodium nitroprusside and 3 drops of 20% NaOH added. The presence of a deep reddish-brown color of yellow is considered to be a positive effect of cardiac glycosides.

#### **Testing for phenolic compounds**

Phloroglucinol tests were used. One percent FeCl<sub>3</sub> was added to 2 ml of extract and the presence of blue, violet, purple, green or brown color was considered the positive effect of phenolic compounds. .

#### **Protein test**

Four milliliters of extraction mixed with 5.0 ml of distilled water and allowed to sit for 3 hours, then boiled. 2 ml of boiled wood was then added to 01 ml of a million reagents and stirred vigorously. The pink rain was considered a protein test.

#### **Test for anthroquinones**

One gram extract was placed in a dry test tube and 20 mL of chloroform was added. This is heated in a steam bath for 5 minutes. The extract was filtered during the heat and allowed to cool. 2 mL of filtrate was mixed with an equal volume of 10% ammonia solution and stirred vigorously. The presence of a pink colour in bricks has been considered a positive effect of anthraquinones.

#### **Antioxidant Potential**

Antioxidant properties of the selected extracts were evaluated by observing the scavenging of mimicking free radicals (decolorization of DPPH<sup>•</sup> radical and conversion of ABTS<sup>•+</sup> radical cation to ABTS) in DPPH and ABTS assays and the reducing potential in FRAP assay. The EC<sub>50</sub> (µg extract/mL) of extracts were shown as the bar graphs; however, the scavenging of DPPH<sup>•</sup> and ABTS<sup>•+</sup> radicals were concentration-dependent for all.

#### **Formulations of *Amaranthus Viridis* extract**

The leaves of *Amaranthus viridis* exhibit strong Antidiabetic effect, according to the literature study. Herbal Antidiabetic medicine that is also more effective has become a popular issue. *Amaranthus viridis* is a worldwide annual herb because of its traditional therapeutic significance in the treatment of diabetes and other ailments, by using the wet granulation process, dried powder of macerated extract of *Amaranthus viridis* leaves was formed into tablet dosage form in this study. *Amaranthus viridis*, Glycine max, Starch, Sodium benzoate, Gelatin, Microcrystalline cellulose, Talc, and Magnesium stearate make up the formulation. The *Amaranthus Viridis* leaves need more research to completely understand the underlying mechanism of action.



Fig.1: Herbal Antidiabetic tablets

## **II. CONCLUSION**

In addition, the results of the present study revealed the presence of strong phenolic antioxidant components mainly gallic acid, kaempferol, and chlorogenic acid in *Amaranthus viridis* extract as evidenced from UPLC-MS/MS. The current study reveals that the plant extracts have excellent pharmacological properties. Further studies are needed to



identify and isolate the bioactive compounds present in the evaluated plant species. Thus, these *Amaranthus viridis* leaf extracts might be utilized as natural agents in pharmaceutical and food industries.

**REFERENCES**

- [1]. Antioxidant And Anticancer Activities Of Selected Indian Medicinal Plant Viz., Artocarpus Lakoocha, Kigelia Pinnata, And Amaranthus Viridis, By Tanveer Ahamad, June 2020.
- [2]. Kiritkar Kr, Basu Bd. Indian Medicinal Plants. Vol. 3. 2nd Ed. In: Kirtikar Kr, Basu Bd (Eds). Dehra Dun, India: International Book Distributors; 1987, 2061-2062.
- [3]. Council of Scientific and Industrial Research (Csir). Publications and Information Directorate. The Wealth Of India. Vol. 1. A Dictionary Of In-Dian Raw Materials And Industrial Products. New Delhi, India: 1988. 221 P.
- [4]. Agra Mf, Baracho Gs, Nurit K, Basilio Ijld, Coelho Vpm. Medicinal And Poisonous Diversity Of The Flora Of "Cariri Paraibano" Brazil. J Ethno-Pharmacol 2007; 111(2):283-395.
- [5]. Sena Lp, Vanderjagt Dj, Rivera C, Tsin Atc, Muhamadu I, Mahamadou O, Et Al. Analysis Of Nutritional Components Of Eight Famine Foods Of The Republic Of Nigeria. Plant Foods Hum Nutr 1998; 52(1):17-30.
- [6]. Gallagher, R. S., & Cardina, J. Phytochrome-Mediated Amaranthus Germination I: Effect Of Seed Burial And Germination Temperature. Weed Sci.1998; 46, 48–52.
- [7]. M. B. Nordeide, A. Hatløy, M. Følling, E. Lied And A. Oshaug , Nutrient Composition And Nutritional Importance Of Green Leaves And Wild Food Resources In An Agricultural District, Koutiala, In Southern Mali. 1996; 47(6), 455- 468.
- [8]. Bagepalli Srinivas Ashok Kumar , Kuruba Lakshman , Korala Konta Narsimha Jayaveera , Devangam Sheshadri Shekar , Chinna Swamyvel Muragan , And Bachappa Manoj , Antinociceptive And Antipyretic Activities Of Amaranthus Viridis Linn In Different Experimental Models. Avicenna Journal of Medical Biotechnology.2009; 1(3): 167-171.
- [9]. Muhammad Javid Iqbal, Sumaira Hanif, Zahed Mahmood, Farooq Anwar and Amer Jamil Antioxidant And Antimicrobial Activities Of Chowlai (Amaranthus Viridis L.) Leaf and Seed Extracts. Journal of Medicinal Plants Research. 2012; 6(27), 4450-4455.
- [10]. Ashok Kumar Bs, Lakshman K, Narayan Swamy Vb, Arun Kumar Pa, Sheshadri Shekar D, Manoj B, Vishwantha GI Hepatoprotective And Antioxidant Activities Of Amaranthus Viridis Linn. Macedonian Journal of Medical Sciences. 2011 Jun 15; 4(2):125-130. Doi:10.3889/Mjms.1857- 5773.2011.0163 Basic Science
- [11]. Ashok Kumar Bs, Lakshman K, Jayaveea Kn, Sheshadri Shekar D, Saleemulla Khan, Thippeswamy Bs, Veerapur Vp Antidiabetic, Antihyperlipidemic And Antioxidant Activities Of Methanolic Extract Of Amaranthus Viridis Linn In Alloxan Induced Diabetic Rats. 2012; 64(1-2):75-79.
- [12]. Sravan Prasad Macharla,Venkateshwarlu Goli, K Vijaya Bhasker, P. Suvarna Devi Ch. Dhanalakshmi, Ch. Sanjusha, Effects Of Anti-Inflammatory Activity Of Amaranthus Viridis Linn. Scholars Research Library Annals Of Biological Research, 2011, 2 (4): 435-438.
- [13]. Ashok Kumar, B.S, Lakshman, K, Jayaveera, K.N., Nandeesh, R., Manoj, B. And Ranganayakulu, D, Comparative In Vitro Anthelmintic Activity Of Three Plants From The Amaranthaceae Family. Arch. Biol. Sci., Belgrade. 2010;62(1),185-189. Doi: 10.2298/ Abs 1001185 k .
- [14]. Bruna Carminate, Giordano Bruna Martin,Roney Martinho Barcelos,Ivoney Gontijo,Marcelo Suzart De Almeida,Valdenir Jose Belinelo Evaluation Of Antifungal Activity Of Amaranthus Viridis L. (Amaranthaceae) On Fusariosis By Piper Nigrum L. And On Anthracnose by Musa Sp. Agricultural Journal. 2012; 7(3):215-219.
- [15]. Girija Krishnamurthy, Kuruba Lakshman, Nagaraj Pruthvi, And Pulla Udaya Chandrik Department Of Pharmacognosy, Peoples Educational Society, College Of Pharmacy, Bangalore - 560 050, Karnataka, India. Correspondence To: Dr. K. Lakshman, E-Mail: DrLakshman26@Rediffmail.Comantihyperglycemic And Hypolipidemic Activity Of Methanolic Extract Of Amaranthus Viridis Leaves In Experimental Diabetes, Indian J Pharmacol. 2011; 43(4): 450–454.

- [16]. Girija K, Lakshman K, Udaya Chandrika, Sabhya Sachi Ghosh, Divya T. Anti-Diabetic and Anti-Cholesterolemic Activity Of Methanol Extracts Of Three Species Of Amaranthus. *Asian Pac J Trop Biomed.* 2011;1(2):133-8. Doi: 10.1016/S2221-1691(11)60011-7.
- [17]. Sena Lp, Vanderjagt Dj, Rivera C, Tsin At, Muhamadu I, Mahamadou O, Millson M, Pastuszyn A, Glew Rh, Analysis Of Nutritional Components Of Eight Famine Foods Of The Republic Of Niger. *Plant Foods Hum Nutr.* 1998; 52(1):17-30.
- [18]. Brenan, J.P.M. The Genus Amaranthus in Southern Africa. *Journal of South African Botany.* 1981; 47: 451–492.
- [19]. Musharaf Khan, Shahana Musharaf, Mohammad Ibrar and Farrukh Hussain Pharmacognostic Evaluation Of The Amaranthus Viridis L Research In Pharmaceutical Biotechnology. 2011; 3(1), 11-16.
- [20]. Hamid Kheyrodin, Isolation and Identification Of New Eleven Constituents From Medicinal Plant. *International Journal Of Nutrition And Metabolism.* 2009; 1(2) 014-0191.
- [21]. Muhammad Islam, Ejaz Ali, Muhammad Asif Saeed, Muhammad Jamshaid and Muhammad Tahir Javed Khan. Antimicrobial And Irritant Activities Of The Extracts Of Malva Parviflora L., Malvastrum Coromandelianum L. And Amaranthus Viridis L. –A Preliminary Investigation, 42.Pak. J. Pharm. 20-23 (1 & 2), 3-6, 2007-2010 Issn: 1019-956x.
- [22]. G Saravanan, P Ponmurugan, M Sathiyavathi, S Vadivukkarasi, S Sengottuvelu, Cardioprotective Activity of Amaranthus Viridis Linn: Effect On Serum Marker Enzymes, Cardiac Troponin And Antioxidant System In Experimental Myocardial Infarcted Rats. *Int J Cardiol.* 2013; 25; 165(3):494-8. Doi: 10.1016/J.Ijcard.2011.09.005.
- [23]. Kaur N, Dhuna V, Kamboj Ss, Agrewala Jn, Singh J. A Novel Antiproliferative and Antifungal Lectin From Amaranthus Viridis Linn Seeds. *Protein Pept Lett.* 2006; 13(9):897-905.
- [24]. Formulation And Evaluation Of Herbal Antidiabetic Tablets By 2022, Rutika Wakchaure, DOI: <http://doi.one/10.1729/Journal.30606>