

STUDY ON NUTRITIONAL VALUE AND ANTIDIABETIC ACTIVITY OF *SWIETENIA MACROPHYLLA* KING SEED (MAHOGANY)

Khine Khine Lin¹, Myat Hsu Mon²

Abstract

This research deals with the study on nutritional value and antidiabetic activity of seed of *Swietenia macrophylla* King (Mahogany). Mahogany fruits were collected from Hinthada University campus. In the preliminary phytochemical investigation, it was found that alkaloids, phenolic compounds, flavonoids, steroids, terpenoids, tannins, saponins, carbohydrates, reducing sugars, glycosides and trace amount of cyanogenic glycosides were present in the seed whereas α - amino acid was not detected. Determination of the nutritional values of the seed provided 24.03 % of crude fat, 14.70 % of protein, 13.03 % of dietary fiber, 8.45 % of moisture, 3.15 % of ash and 36.64 % of carbohydrate. According to ED-XRF analysis, the elemental composition of the seed was found to be potassium (1.145 %), phosphorus (0.526 %), sulphur (0.227 %), calcium (0.190 %), iron (0.004 %) and minor components (0.002 %) of Mn, Zn and Cu. After that, the antidiabetic activity of the seed was evaluated by alpha amylase inhibition assay method. IC₅₀ values of the extracts were found to be 0.069 mg/mL of ethanol, 0.096 mg/mL of ethyl acetate and 0.168 mg/mL of water extracts.

Keywords: *Swietenia macrophylla* King Seed, phytoconstituents, nutritional values, antidiabetic activity, IC₅₀

Introduction

In the plant kingdom, there are thousands of plants known and unknown, that yield medicine or drugs of great use to man. According to the World Health Organization (WHO), more than 80 % of the world's population in developing countries relies on traditional medicine for their primary health care needs. Natural products from medicinal plants, either as pure compounds or as standardized extracts from medicinal plants provide unlimited opportunities for new drug leads because of the unmatched availability and chemical diversity of bioactive principles from the plant Kingdom (Sasidharan *et al.*, 2011). Myanmar is a country considered to be rich in medicinal plants genetic resources. *Swietenia macrophylla* King is one of the valuable medicinal plant in Myanmar.

It is beautiful, lofty, evergreen hardwood timber species of the family Meliaceae. The plant is native to America, Mexico, South America and India. It is extended in most tropical countries especially in Brazil, Philippines, Peru, Malaysia, Singapore and Myanmar.

Medicinal Uses of *Swietenia macrophylla* King

Abundance health benefit that the seeds have is mainly because the seeds contain huge amount of flavonoids and saponins. Especially, the seed extracts have medical efficacy. The seeds have many uses such as in the treatment of hypertension, against chest pain, insect repellent, relieve constipation and menstrual pain, lessen the cholesterol level, increase appetite, fight free radical, prevent colon cancer, boost the immune system and against leishmaniasis. The seeds are very bitter in taste and it has effective in lowering blood sugar level especially if suffer from diabetes. A decoction of the crushed seeds of *S. macrophylla* is also used to treat skin

¹ Dr, Lecturer, Department of Chemistry, West Yangon University

² MSc Student, Department of Chemistry, Hinthada University

aliments and wounds. The seed extracts are used to cure malaria, anemia, diarrhoea, dysentery, eczema, rheumatism, cancer, cough, cold and fever (Goh *et al.*, 2011).

Nowadays, they are more widely available often in capsule form, as a dietary supplement. People grind the seeds into powder and drink them with water. For diabetics, taking half of tea spoon powdered *S.macrophylla* seed with warm water before a meal may help keep their blood sugar steady. These make them become nutritionally rich, as rich as ginseng. Furthermore, it has possessed a wide array of biological properties such as antidiabetic, anti-microbial, anti-inflammatory, anti-mutagenic, antioxidant, antifungal, antibacterial and anti-obesity activities. In addition, it also contains many natural nutrients that can sustain a healthy body and increase the overall energy of the human body such as protein, minerals, vitamins, fiber, carbohydrates, folic acid, essential fatty acid and so on. Seed kernels yield oil which is very bitter and purgative. The essential oils which are extracted from Mahogany seeds are also used to re-vitalize skin (Amitava *et al.*, 2006).

The leaf decoction is used against nerve disorders and bleeding. It contains a sizeable amount of total phenolic, tannins and flavonoid contents. Leaves of *S.macrophylla* have been reported significantly for the prescription of febrifuge, colds, cataract and diarrhoea. The leaves have also been found anti-diabetic, anti-bacterial, anti-oxidant, anti-microbial, anti-fungal, anti-diarrhoeal, anti-malarial and anti-inflammatory (Hasnash *et al.*, 2009).

Traditionally, the bark decoction of *S. macrophylla* is used to treat anemia, diarrhoea, dysentery, fever, tuberculosis, loss of appetite and toothache. The bark contains tannin and may serve as an anti-pyretic, tonic and astringent for wounds. In addition, its bark is used for curing psoriasis, hypertension, diabetes, malaria and epilepsy as a folk medicine. It can be inhibited growth of cancer tumors (Panda *et al.*, 2010).

The photograph of *S. macrophylla* is shown in Figure 1.

Botanical Characteristics of *Swietenia macrophylla* King

Family	: Meliaceae
Genus	: <i>Swietenia</i>
Species	: <i>macrophylla</i>
Scientific name	: <i>Swietenia macrophylla</i>
English name	: Big leaf mahogany
Myanmar name	: Mahogany
Part used	: Seed



Figure 1 Photographs of *S. macrophylla*

Materials and Methods

Sample Preparation

The fruits of the *S. macrophylla* (Mahogany) were collected from Hinthada University Campus, Ayeyawady Region. The plant was identified by Department of Botany, Hinthada University. The seeds were obtained after removing the hard shell of the fruits. The collected *S. macrophylla* seeds were dried under shadow for four weeks. The dried seeds were ground into powdered form with electric grinder and stored in air tight container to prevent moisture and other contamination.

Determination of Nutritional Value

The nutritional values such as protein, fiber, fat and carbohydrates were also determined. The fat content was determined by the soxhlet extraction method. The protein and fiber content were also studied by acid alkali treatment. The quantitative analyses for the determination of total ash and moisture contents have been done according to AOAC methods (AOAC 1990). The relative abundance of the elements present in seed of the *S. macrophylla* was also determined by Energy dispersive X-ray fluorescence spectrometer (Shimadzu EDX-900).

Investigation of Antidiabetic Activity on the Seed of *S. macrophylla* by α Amylase Assay

Preparation of crude extract by successive solvent extraction method

100 g of the dried seed sample was extracted with petroleum ether (350 mL) by Soxhlet extractor for about 3 h. Then the defatted residue was refluxed with 350 mL of respective solvents (ethanol, ethyl acetate). The soluble portion of the each solvent was obtained by filtration the mixture of the sample. This procedure was repeated for three times. The combined extracts were evaporated under reduced pressure by means of a rotatory evaporator until one third of original volume was remained. Then the mixture was transferred into the porcelain basin and evaporated until the crude extract was obtained. Different crude extracts of ethanol and ethyl acetate were obtained.

The preparation of watery crude extract of the seed sample was carried out according to above procedure.

Screening of antidiabetic activity on the seed of *S. macrophylla*

Accurately weighed, 80 mg of each crude extract was dissolved in 10 mL of buffer solution and thoroughly mixed by shaker. Then it was diluted to 100 mL to obtain the stock solution. Desired concentrations of 0.8 mg/mL, 0.4 mg/mL, 0.2 mg/mL, 0.1 mg/mL, 0.05 mg/mL and 0.025 mg/mL of each solution were prepared from this stock solution by serial dilution with appropriate amount of buffer solution.

Alpha-amylase inhibition activity was determined by UV spectrophotometric method. 1.0 mL of test sample in different concentrations (0.8 mg/mL, 0.4 mg/mL, 0.2 mg/mL, 0.1 mg/mL, 0.05 mg/mL and 0.025 mg/mL) and 1.0 mL of α -amylase solution were added into each test tube. Then all the test tubes were incubated for 10 min at 25 °C. After incubation, 1.0 mL of 1 % starch solution was also added and incubated again for 5 min at 25 °C. After that, 2 mL of

dinitrosalicylic acid was added into these test tubes. The test tubes were again incubated in boiling water for 5 min and cooled at room temperature. The sample solutions were obtained.

Control solution was prepared by using the same procedure replacing the test sample with distilled water.

Blank solution was also prepared without addition of α -amylase replaced by equal amount of buffer solution.

The sample solution, control solution and blank solution were allowed to stand at room temperature for 30 min. After 30 min the absorbance of these solutions were measured by UV spectrophotometer at 540 nm. Absorbance measurement were done in triplicate for each solution and then mean values so obtained were used to calculate percent inhibition of α -amylase by the equation. The IC₅₀ value (50 % inhibition concentration) were also calculated by linear regressive excel program.

$$\% \text{Inhibition} = \frac{A_{\text{control}} - (A_{\text{test sample}} - A_{\text{Blank}})}{A_{\text{control}}} \times 100$$

% Inhibition = percent inhibition of sample

A_{control} = absorbance of control solution

A_{sample} = absorbance of sample solution

A_{blank} = absorbance of blank solution

Results and Discussion

Nutritional Values of *S.macrophylla* Seed

The fat content of the sample was determined by the Soxhlet extraction method and was found to be 24.03 %. In addition, the sample was also studied for fiber content by acid alkali treatment and protein content by AOAC method. The carbohydrate, fat, protein and fiber contents for *S.macrophylla* seed were found to be 36.64 %, 24.03 %, 14.70 % and 13.03 %, respectively. All the results are shown in Table 1. The greater amount of fat (24.03 %) and protein (14.70 %) in the seed can helps to maintain body temperature, absorb the nutrients and provide energy. Moreover, fiber content (13.03 %) in the seed lowers cholesterol level, maintain body weight and relieve constipation in the body.

The total ash in the sample is the inorganic residue remaining after the organic matter has been burnt away. The moisture content of sample determined by oven dried method was found to be 8.45 % and ash content by using muffle furnace was 3.15 %.

Elemental Compositions of *S.macrophylla* Seed by EDXRF Spectrometry

The relative abundance of elements present in *S.macrophylla* seed determined by EDXRF spectrometer showed 1.145 % for K, 0.526 % for P, 0.227 % for S, 0.190% for Ca, 0.004 % for Fe, 0.002 % for Mn, Zn, and Cu. All the results are represented in Table 2. The EDXRF spectrum obtained is shown in Figure 2. It can be seen that potassium is the major elements in Mahogany seed. Potassium plays many important roles within the body. Potassium is crucial to cardiovascular and nerve functions in our body. It is particularly important for the ability of our skeletal and smooth muscles to contract. But it can be lost in diuretic therapy for edema or hypertension.

Table 1 Some Nutritional Values of *S.macrophylla* Seed

No.	Components	Content (%)
1.	Fat	24.03
2.	Protein	14.70
3.	Fiber	13.03
4.	Moisture	8.45
5.	Ash	3.15
6.	Carbohydrate	36.64

Table 2 Relative Abundance of some Elements in *S. macrophylla* Seed by EDXRF Method

No	Elements	Relative Abundance (%)
1.	Potassium(K)	1.145
2.	Phosphrous (P)	0.526
3.	Sulphur (S)	0.227
4.	Calcium (Ca)	0.190
5.	Iron (Fe)	0.004
6.	Manganese (Mn)	0.002
7.	Zinc (Zn)	0.002
8.	Copper (Cu)	0.002
9.	Hydrocarbon (CH)	97.902

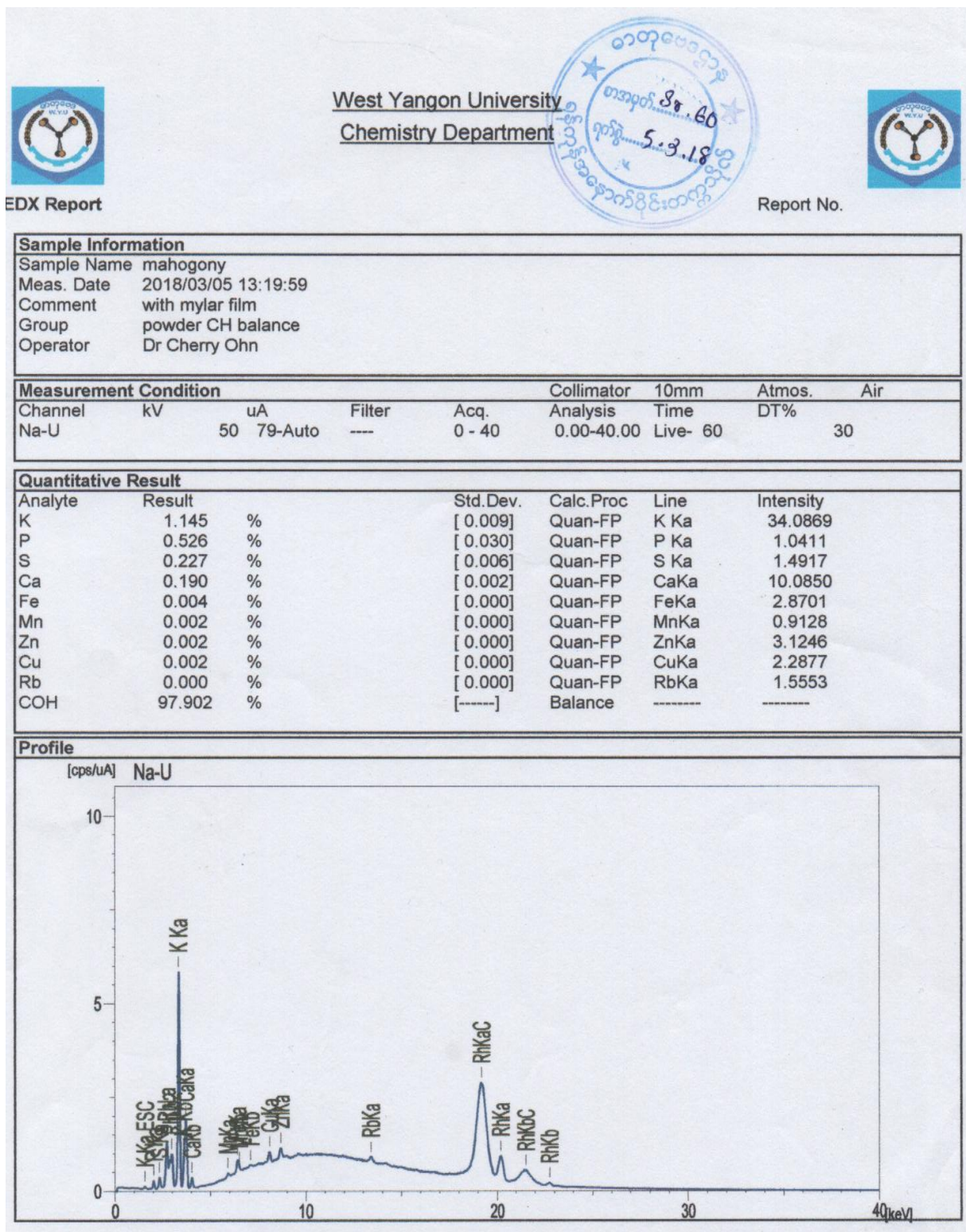


Figure 2 EDXRF spectrum of *S. macrophylla* Seed

Antidiabetic Activity of *S. macrophylla* Seed

The antidiabetic activity of the seed sample was studied by α - amylase inhibition assay. Alpha-amylase is an enzyme that cleaves an internal glycosidic bond within a poly or oligosaccharide. It catalyzes the hydrolytic cleavage of polysaccharides into absorbable monosaccharides. The inhibition of α -amylase decreases rate of hydrolytic cleavage of carbohydrate and slows the elevation of blood sugar in the body. Therefore, the percentage of α -amylase inhibition represents for antidiabetic activity of the sample and expressed in terms of IC₅₀ value (50 % inhibition concentration). The lower IC₅₀ value showed the higher α -amylase inhibition (greater antidiabetic activity). All the extracts of the seed possesses inhibition property. The inhibition percentage and IC₅₀ value of the different extracts of the seed were represented in Table 3. Among the extracts, ethanol extract possesses higher inhibition percent due to lower IC₅₀ value of 0.069 mg/mL. The graphical representation of IC₅₀ values of the extracts is shown in Figure 3. It was found that IC₅₀ value of ethanol extract (0.069 mg/mL) is not much differ from the IC₅₀ value of standard Acarbose (Antidiabetic drug).

Therefore, the seed of *S. macrophylla* can be used as an antidiabetic agent in the treatment of diabetes mellitus.

Table 3 α –Amylase Inhibition Percentage and IC₅₀ Values of Different Extracts of Seed of *S. macrophylla*

Extracts	Inhibition (%) (Mean \pm SD) in different concentrations (mg/mL)						IC ₅₀ (mg/mL)
	0.025	0.05	0.1	0.2	0.4	0.8	
Ethyl acetate	33.00 \pm 1.7	42.85 \pm 1.5	50.61 \pm 1.9	63.63 \pm 1.6	67.47 \pm 1.7	77.52 \pm 1.2	0.096
Ethanol	37.50 \pm 1.9	45.20 \pm 0.44	57.89 \pm 1.5	66.67 \pm 1.1	77.77 \pm 1.7	80.09 \pm 1.3	0.069
Watery	29.82 \pm 1.7	44.44 \pm 1.5	48.71 \pm 0.3	50.61 \pm 0.7	57.44 \pm 0.2	61.54 \pm 0.4	0.168
Acarbose	40.86 \pm 1.5	52.37 \pm 1.7	59.62 \pm 1.6	68.48 \pm 0.9	79.65 \pm 0.8	82.77 \pm 1.3	0.047

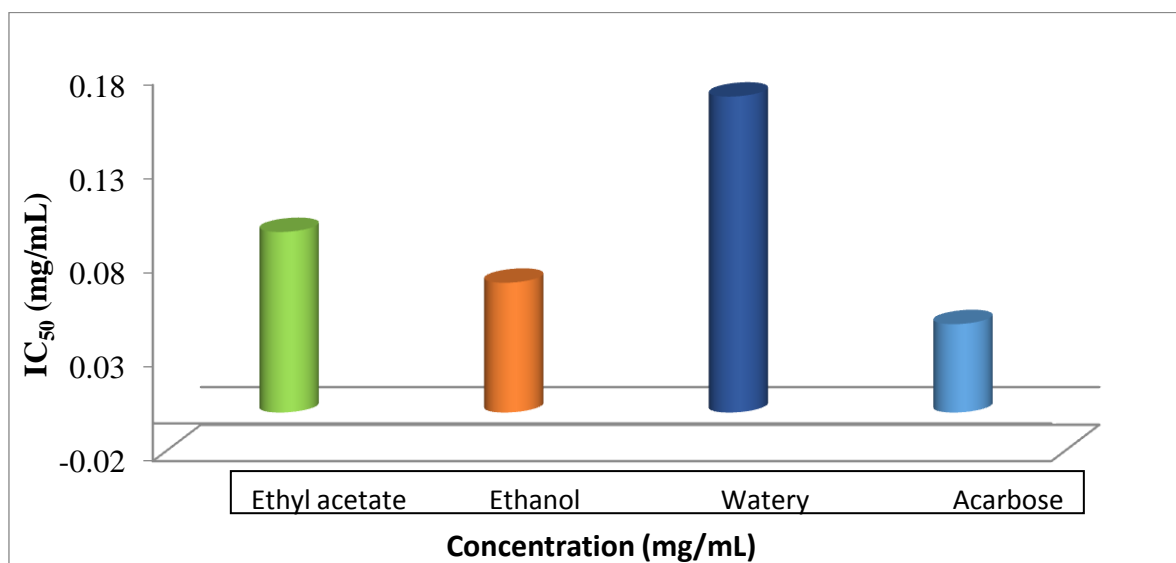


Figure 3 A bar graph of IC₅₀ values of crude extracts of *S. macrophylla* seed compared with standard acarbose

Conclusion

The nutritional values and elemental composition of seed of *S. macrophylla* (Mahogany) from Myanmar were studied by AOAC method and ED-XRF Spectrometry. It was observed that 24.03 % of crude fat, 14.70 % of protein, 13.03 % of dietary fiber, 8.45 % of moisture, 3.15 % of ash and 36.64 % of carbohydrate were present in dried seed sample. The greater amount of fats, protein and fiber in *S. macrophylla* seed are essential nutrients for the body processes, brain development and nerve function. The elemental composition of the Mahogany seed by EDXRF showed potassium (1.145 %), phosphorous (0.526 %), sulphur (0.227 %), calcium (0.190 %), iron (0.004 %) and of Mn, Zn, and Cu (0.002 % each). The seed of Mahogany also possesses potassium (1.145 %) than the other elements. Potassium is one of the most common mineral and plays a vital role in heart function. In medicine, the natural sources rich in potassium are low in sodium, helping to maintain normal blood pressure. It is crucial to cardiovascular and nerve functions. Antidiabetic activity (α -amylase inhibition) was exhibited in terms of IC₅₀ value. Ethanol extract showed the lowest IC₅₀ value (0.069 mg/mL) followed by ethyl acetate (0.096 mg/mL), and watery (0.168 mg/mL). The lower the IC₅₀ value, the greater the antidiabetic activity. The present study scientifically proved that the seed of Mahogany possesses antidiabetic property. This finding provides the Mahogany seed contains valuable natural nutrients for healing and improve the blood circulation system in the body. Therefore, *S. macrophylla* seed is considered rare privilege of any herbaceous plant in the world.

Acknowledgements

The authors would like to express their profound gratitude to Myanmar Academy of Arts and Science for allowing to present this paper. We also express our appreciation to Professor and Head, Dr Hlaing Hlaing Oo, Professor Dr Sanda Khar, Department of Chemistry West Yangon University for their kind supervision and encouragement to present this research work.

References

- Amitava, D., Sunilson, J. A. J., Kiran, N. and Rejitha, G (2009). "Antinociceptive Activity of the fruit of *Swietenia macrophylla* King". *Journal of Pharmacy Research*, vol. 2(9), pp.1367-1369
- AOAC, (1990). *Official and Tentative Methods of Analysis the Association of Official Agriculture Chemists*. Washington D C : 11th Ed., pp. 526
- Goh, H.B. and Abdul, A. H. (2011). "In Vitro Cytotoxic Potential of *Swietenia macrophylla* King Seeds against Human Carcinoma Cell lines". *J of Medicinal Plants Res.*, vol. 5(8), pp.1395-1404
- Hanash, O., Tan, S. K., Wong, K. C., Boey, P. L. and Ibrahim, P. (2009). "Antimicrobial and Antioxidant Activities of *Swietenia macrophylla* leaf extracts". *As.J.Food Ag-Idn*, vol. 2(02), pp.181-188
- Panda S.P., Bera, S., Haldar P. K., Adhikary, S., Kandar C C (2010). "Antidiabetic and Antioxidant Activity of *Swietenia macrophylla* King in Streptozotocin-induced Diabetic Rats". *Pharmaceutical Biology*, vol. 48(9), pp. 974-979
- Sasidharan, S., Chen, Y., Saravaran, D., Sundram, K. M. and Latha, L. Y (2011). "Extraction, Isolation and Characterization of Bioactive Compounds from Plant's Extracts". *Afr J Tradit Complement Altern Med.*, vol. 8(1), pp.1-10