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SWIETENIA MAHAGONI SEEDS ATTENUATE HYPERGLYCEMIA AND PROTECT LIVER IN ALLOXAN-INDUCED DIABETIC RATS

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ABSTRACT: The present study was designed to investigate the chemical composition of *Swietenia mahagoni* seeds , identification of phenolic compounds in acetone extract in *mahagoni* seeds, studying the fatty acids composition, and evaluation of *mahagoni* extracts and oil on the glucose level of diabetes rats. The chemical composition of seeds were moisture (3.6 %), crude fiber (14 %), ash (3%), crude protein (13 %), crude fat (7.4 %) and total carbohydrate (62.6 %). The fatty acids composition were lignoceric acid (C24) 38.23% followed by stearic acid (C18) 35.69%, meanwhile the unsaturated fatty acid was linoleic acid (C18:2), which accounted for (26.08 %). The phenolic compound in acetone extract showed that menthol and nerolidol are the major phenolic (12.32 and 10.06 % respectively). Ttreatment with *Swietenia mahagoni* seed extracts and oil decreased significantly glucose level , also decreased significantly GOT , GPT , ALP , urea , creatinine and malondialdehyde level as compared with hyperglycemic group .

Key words: Swietenia mahogany, Alloxan,hyperglycemia,diabetes.

INTRODUCTION

***Swietenia mahagoni* Jacq. is a small, leafy, medium sized tree found in India and some African countries, but native to West Indies. Across the world, the plant is commonly called West Indies mahogany, caoba, caob dominicana or acajou. It is one of the species of genus *Swietenia* which belongs to chinaberry family, Meliaceae. Elbert (1978). Fatty acid composition of *S. mahagoni* seed oil was determined as their methyl esters prepared by boron-trifluoride methanol complex , fatty acid range C16:0 to C20:0 in *S. mahagoni* seed oils containing saturated and unsaturated fatty acids. The linoleic acid enriched in fatty acid profile 30.1%. Linoleinic acid was found to be 13.5% . In the saturated fatty acids profile, stearic acid was the highest estimated as 15.8% in *S. mahogany* seed oils. The moisture contents of *S. mahagoni* seeds were found to be 15.2%. The lipid contents were 57.9%. Ash contents was estimated as 2.8% in *S. mahagoni* while total protein (N×6.25) of *S. mahagoni* seeds was 13.0% of which 7.5% was water soluble. Crude fiber contents estimated as 1.4% and carbohydrate contents were determined to be 9.7%. Ali et al., (2011). the potentiality of the extract of *S. mahagoni* seed for the correction of diabetes and its related complications like oxidative stress and hyperlipidemia. The extract may be a good candidate for developing a safety, tolerable, and promising neutraceutical treatment for the management of diabetes, De et al., (2011). The ethanolic extract of Swietenia mahagoni seeds has hypoglycaemic effect in experimentally induced diabetic rats which requires further investigation, Mahid-Al-Hasan et al., (2011). Aqueous-methanol extract of *S. mahagoni* seed has been reported to exhibit hypoglycemic and antihyperlipidemic potency in streptozotocin-induced diabetic rats. Oral feeding of the extract to diabetic rats for 21 d lowered the blood glucose level and improved liver glycogen content. Furthermore,**

treatment with the seed extract normalized the levels of serum urea, uric acid, creatinine, cholesterol, triglyceride and lipoproteins. In addition, the extract increased the activity of antioxidant enzymes and reduced the oxidative stress in liver, kidney and skeletal muscles De et al., (2011).

The aim of the present investigation was to evaluate the influence of *S. mahagoni* seed oil and seed extracts on serum lipids, liver and kidney function of hyperglycemic rats on biochemical and biological changes that may occur to diabetic rats.

MATERIALS AND METHODS

Materials:

Mahagoni seeds were collected from research center department of medical and aromatic plants. Giza Egypt. The seeds were dried and milled.

Methods :

Preparation of crude extracts from *Swietenia mahagoni* seeds:

Methanol, acetone and water extracts of *Swietenia mahagoni.* seeds were prepared by cold maceration technique.

Extraction of seed oil:

Oil extraction and degumming were carried out using the method described by Tsaknis et al. (1998). The seed oil was extracted by solvent extractions using n-hexane (H) .

Proximate composition:

The methods of the Association of Official Analytical Chemists AOAC, (1990) were used for proximate analysis. Mahagoni seeds samples (5 grams) was used for determination of moisture content by weighing in crucible and drying in oven at 105^{o}C, until a constant weight was obtained. Determination of ash content was done by ashing at 550^{o}C for 3h. The Kjeldahl method was used to determine the protein content. The crude fibre content of the samples was determined by digestion method and the fat was done by Soxhlet extraction method. All determinations were done in triplicate. The carbohydrate content of the test sample was determined by estimation using the arithmetic difference method Pearson (1976).

%CHO = 100 – (% fat. + % ash + % fiber + % protein)

Identification of fatty acids:

Saturated, unsaturated and total fatty acids were determinate in the oil by using methyl esters boron trifluoride method A.O.A.C (2012) , the oil is saponified with sodium hydroxide in methanol .the fatty acids are methylised with boron tri fluoride in methanol, extracted with heptanes and determined on a gas chromatograph with FID detector (PE auto system XL) with auto sampler and Ezchrom integration system . Carrier gas (He), ca.25 Psi –air 450 ml/min –Hudrogen 45 ml – split 10 ml/min . oven temperature 200 C injector and detector 250 C.

Identification of Mahagoni acetone extract :

GC / MS analysis : the analysis was carried out using a GC (Agilent Technologies 7890 A) interfaced with a mass – selective detector (MSD,Agilent 7000) equipped with an apolar Agilent HP-5ms (5%-phenyl methyl poly siloxane)capillary column (30 m×0.25 mm i.d. and 0.25 um film thickness) the carrier gas was helium with the linear velocity of ml/min . The identification of components was based on compartion of their mass spectra and retention time with those of the authentic compounds and by computer matching with NIST and WILEY library as well as by compartion of the fragmentation pattern of the mass spectral data with those reported in the literature.

Biological Evaluation:

Animals:

Adult male albino rats Sprague Dawely strain weighing between (90 – 100) gm , were obtained from the animal house of Egyptian Organization for biological Products and Vaccines (VACSERA) Cairo, Egypt. The animals were kept in wire cages with wire bottom. The diet was introduced to the rats in special feed cup that kept food spilling to a minimum, water was provided to the rats by means of glass tube projecting through wire cage, an inverted bottle supported one side of the cage.

Blood sampling and analysis:

Blood samples were collected after six weeks in tubes contain heparin as an anticoagulant from the eye plexuses under diethyl ether anesthesia and then centrifuged at 3000 rpm for 20 min. to obtain plasma, which was kept frozen until analysis. Blood glucose was determined according to enzymatic method of Tinder, (1969). The total cholesterol was analyzed calorimetrically according to Allain et al. (1974) method . The triglycerides were analyzed according to Fossati and Prencipe (1982) method. Alanine-aminotransferase (ALT) and aspartate-aminotransferase (AST) activities were measured according to the method described by Reitman and Frankel (1957). Alkaline phosphatase (ALP) activity was measured by the method of Hausamen et al., (1967). Urea and creatinine were determined according to Young (2001). Malondialdehyde was determined in plasma as described by Satoh, (1978). Catalase activity was determind in plasma as described by Aebi (1984)

Statistical analysis:

The results of the animal experiments were expressed as the Mean ± SE and they were analyzed statistically using the one-way analysis of variance ANOVA followed by Duncan's test. In all cases $p<0.05$ was used as the criterion of statistical significance.

RESULTS AND DISCUSSION

Proximate composition of Mahagoni seeds:

Proximate compositions of Mahagoni seeds are presented in Table 1. *Swietenia mahagoni* seeds consisted of moisture (3.6 %), crude fiber (14 %), ash (3%), crude protein (13 %), crude fat (7.4 %) and total carbohydrate (62.6 %). Our data are in line with that of Ali et al., (2011). Who reported that ash and crude protein percent of *S. mahagoni* seeds were determined. Ash contents was estimated as 2.8% while total protein (N×6.25) of *S. mahagoni* seeds was 13.0%.

Table 1: Proximate composition of Moringa seeds (w/w%)

Constituents	Percentage (w/w %)
Moisture content	3.6
Crude fibre content	14
Total ash	3
Protein content	13
Crude Fat content	7.4
Carbohydrate content	62.6

Fatty acids composition:

Data demonstrated in Table (2) Showed that fatty acids of *Swietenia mahagoni* oil contained 26.08% unsaturated fatty acids and 73.92 % saturated fatty acid. the unsaturated fatty acid was linoleic acid (C18:2), which accounted for (26.08 %) of the total fatty acid. Mean while the most abundant saturated fatty acids were lignoceric acid (C24) 38.23% followed by stearic acid (C18) 35.69%.

These data are in agreement with those obtained by Ali et al., (2011) who reported that, linoleic acid enriched in fatty acid profile 30.1% in *S. mahagoni*, may be the precursor of prostaglandins (known to occur in accessory genital gland, seminal plasma and lung tissue of human body) and play a vital role in human health .Also Harlem (2003) reported that, methyl linoleate was (30.55%) in *S. mahagoni*, oil.

Chemical composition of Mahagoni acetone extract:

Phenolic compounds in acetone extract of seeds for *Swietenia mahagoni* were analyzed by GC/MS, and concentration of all tested phenolic compounds are given in Table (3).

From this table it was found that *Swietenia mahagoni* seeds contains (32) phenolic compounds. Analysis of *Swietenia mahagoni* acetone extract of seeds showed that menthol and nerolidol are the major phenolic (12.32 and 10.06 % respectively).

These results are compatible with those reported by Pharm et al. (2011).

Table 2: Fatty acids composition of Moringa oil:

Fatty acids	Name	Concentration %
1	Linoleic acid	26.08
2	Stearic acid	35.69
3	Lignoceric acid	38.23

Table 3: Phytocomponents identified in the acetone extract of *Swietenia mahagoni* by GC-MS:

No	Compound	%	No	Compound	%
1	Dimethyl sulfoxide	3.95	17	Squalane	1.16
2	L-(-)-Fucose	3.58	18	Cyanidin cation	2.77
3	Resorcinol	0.67	19	Myricetin	0.95
4	4-Methylcatechol	0.08		Ledane	6.95
5	Phenol,2,6-dimethyl	2.97	21	7,8-Dihdro-α-ionone	5.91
6	2-Methoxy-5 methylphenol	2.78	22	Caryophyllene oxide	5.25
7	2'-Hydroxy-4'-methoxyacetophenone	0.48	23	Perillal	1.58
8	citronellol	2.37	24	Dodecanedioic acid	4.35
9	Eugenol	0.53	25	Kaempferol	3.82
10	Cinnamic acid,p-hydroxy-,methyl ester	0.20	26	Citronellyl tiglate	9.85
11	Phenol,3,5-di-tert-butyl-	0.52	27	Nerolidol	10.06
12	Flopropion	0.22	28	Menthol	12.32
13	Hexestrol	0.24	29	Apigenin 8-C-glucoside	4.04
14	4',7-Dimethoxyisoflavone	0.25	30	3,5-di-t-Butylcatechol	1.05
15	3,5-Dimethoxycinnamic acid	0.92	31	Thunbergen	3.69
16	Methyl tri-O-methylgallate	0.29	32	Cumaldehyde	6.07

In vivio study of the effect of *Swietenia mahagoni* extracts and oil on hyperglycemic rats:

Body weight, glucose level and lipids profile:

The effect of *Swietenia mahagoni* extracts and oil on hyperglycemic rats for 30 days on the body weight , glucose level and lipids profile of albino rats are illustrated on Table (4), which represent the mean values through the whole period. Data indicated that body weight in normal group of albino rats were 233 gm, while in hyperglycemic group body weight of albino rats were 172 gm after 30 days, the *Swietenia mahagoni* extracts and oil (group III , IV , V and VI) and glibenlamide group reached 240 , 231 , 225, 224 and 236g respectively. Increased significantly body weight of albino rats treated with *Swietenia mahagoni* extracts and oil compared with hyperglycemic rats.

Glucose level in normal group of albino rats were 95.4 mg/dl, while in hyperglycemic group glucose level of albino rats were 440.4 mg/dl after 30 days, the *Swietenia mahagoni* extracts and oil (group III , IV , V and VI) and glibenlamide group reached 93.6 , 93.2 , 134.6 , 104.8 and 87.8 mg/dl respectively . reduced significantly glucose level of albino rats treated with *Swietenia mahagoni* extracts, oil and glibenlamide compared with hyperglycemic rats.

Plasma total cholesterol in normal group of albino rats were 160 mg/dl , while in hyperglycemic group total cholesterol level of albino rats reached 148.4 mg/dl after 30 days , the *Swietenia mahagoni* extracts and oil (group III , IV , V and VI) and glibenlamide group reached 149.2 , 148.8 , 164 , 155.8 and 160.6 mg/dl respectively, plasma triglycerides in normal group of albino rats were 133.6 mg/dl, while in hyperglycemic group triglycerides level of albino rats reached 106 mg/dl after 30 days, the *Swietenia mahagoni* extracts and oil (group III , IV , V and VI) and glibenlamide group reached 145.6, 142.6 , 129 , 126.8 and 136.8 mg/dl respectively .

Our data are in line with that of De et al., (2011), Maiti et al., (2009) and Kalaivanan & Pugalendi (2011).

Table 4: Effect of *Swietenia mahagoni* extracts and oil on body weight glucose level and lipids profile of rats :

Group	Weight (gm)	Glucose (mg/dl)	cholesterol (mg/dl)	Triglycerides (mg/dl)
Negative control group	233 ^{a}± 1.48	95.4^{ab} ± 5.45	160 ^{ab}±1.16	133.6 ^{ab}± 3.51
Positive control group	172 ^{b}± 0.58	440.4^{d} ± 3.6	148.4 ^{a}±1.88	106 ^{a}± 5.26
Methanol extract group	240 ^{a}± 2.58	93.6^{a} ± 5.17	149.2 ^{a}±4.81	145.6 ^{b}± 5.27
Acetone extract group	231 ^{a}± 2.14	93.2^{a} ± 1.92	148.8 ^{a}±4.14	142.6 ^{b}± 1.95
Water extract group	225 ^{a}± 1.58	134.6^{c} ± 3.84	164^{b}±3.11	129 ^{ab}± 8.84
Oil group	224 ^{a}± 1.98	104.8^{b} ± 3.56	155.8 ^{ab}±2.38	126.8 ^{ab}± 2.16
Glibenlamide group	236 ^{a}± 2.16	87.8^{a} ± 2.86	160.6 ^{ab}±1.92	136.8 ^{b}± 5.45

Liver functions GOT, GPT and ALP activity:

The effect of *Swietenia mahagoni* extracts and oil on hyperglycemic rats for 30 days on GOT, GPT and ALP activity of albino rats are illustrated on Table (5), which represent the mean values through the whole period. Data indicated that Glutamate oxaloacetate transferase (GOT) activity in normal group of albino rats were 22.6 IU/L , while in hyperglycemic group GOT activity of albino rats reached 25.8 IU/L after 30 days , the *Swietenia mahagoni* extracts and oil (group III , IV , V and VI) and glibenlamide group reached 23.2 , 24.2 , 24.2 , 24 and 28.2 IU/L respectively . Glutamate pyrovate transferase (GPT) activity in normal group of albino rats were 20.4 IU/L , while in hyperglycemic group GPT activity of albino rats reached 32.8 IU/L after 30 days , the *Swietenia mahagoni* extracts and oil (group III , IV , V and VI) and glibenlamide group recorded 19.6 , 20 , 20.8 , 21.2 and 23.6 IU/L respectively .

Alkaline phosphatase (ALP) activity in normal group of albino rats were 125 IU/L, while in hyperglycemic group ALP activity of albino rats reached 148.6 IU/L after 30 days , the *Swietenia mahagoni* extracts and oil (group III , IV , V and VI) and glibenlamide group recorded 114 , 120, 128.8, 121.8 and 134.4 IU/L respectively. Reduced significantly GOT, GPT and ALP activity of albino rats treated with *Swietenia mahagoni* extracts, oil and glibenlamide group compared with hyperglycemic rats.

Our data are in line with that of Subhadip Hajra et al., (2011) and Siva Prasad Panda et al., (2010) , who reported that, using of *S. mahagoni* Jacq. seeds as a natural antioxidant and antidiabetic agent.

Table (5): Effect of *Swietenia mahagoni* extracts and oil on GOT , GPT and ALP activity of rats :

Group	GOT (IU/L)	GPT (IU/L)	ALP (IU/L)
Negative control group	22.6^{a} ± 0.54	20.4^{a} ±0.55	125^{bc} ± 2.73
Positive control group	25.8^{c} ± 1.09	32.8^{c} ±2.86	148.6^{e} ± 1.22
Methanol extract group	23.2^{ab} ± 1.3	19.6^{a} ±0.55	114^{a} ± 1.58
Acetone extract group	24.2^{b} ± 0.83	20^{a} ± 1	120^{ab} ±1.58
Water extract group	24.2^{b} ± 1.09	20.8^{a} ± 0.83	128.8^{cd} ±1.48
Oil group	24^{b} ±1.22	21.2^{a} ± 1.92	121.8^{b} ±1.64
Glibenlamide group	28.2^{d} ± 0.83	23.6^{b} ± 1.14	134.4^{d} ±1.67

Kidney functions:

Plasma creatinine and plasma urea:

Results are given in Table (6) represented the mean values through the whole period. Data indicated that plasma urea in normal group of albino rats were 18 mg/dl , while in hyperglycemic group urea level of albino rats reached 35.6 mg/dl after 30 days , the *Swietenia mahagoni* extracts and oil (group III , IV , V and VI) and glibenlamide group recorded 20.4 , 22.6 , 20.6 , 23 and 24.8 mg/dl respectively , plasma creatinine in normal group of albino rats were 0.902 mg/dl , while in hyperglycemic group urea level of albino reached 1.136 mg/dl after 30 days , the *Swietenia mahagoni* extracts and oil (group III , IV , V and VI) and glibenlamide group 0.946 , 0.93 , 0.938 , 0.956 and 0.986 mg/dl respectively. Reduced significantly urea and creatinine levels of albino rats treated with *Swietenia mahagoni* extracts, oil and glibenlamide group compared with hyperglycemic rats. Our data are in line with that of De et al., (2011) , who studied The antidiabetic, antioxidative, and antihyperlipidemic activities of aqueous-methanolic extract of *Swietenia mahagoni* seed in streptozotocin-induced diabetic rats and reported that , the seed extract corrected the levels of serum urea and creatinine level towards the control level in this experimental diabetic model.

Oxidative stress parameters :

Malondialdehyde (MDA) and Catalase (CAT) activity:

Results are given in Table (7) indicated that plasma malondialdehyde in normal group of albino rats were 14.58 mg/dl, while in hyperglycemic group malondialdehyde level of albino rats were 16.87 mg/dl .The *Swietenia mahagoni* extracts and oil (group III , IV , V and VI) and glibenlamide group recorded 15.45 , 16.22 , 15.78 , 15.79 and 14.86 mg/dl respectively . Catalase (CAT) activity in normal group of albino rats were 509 IU/L, while in hyperglycemic group CAT activity of albino rats were 539.2 IU/L , the *Swietenia mahagoni* extracts and oil (group III , IV , V and VI) and glibenlamide group recorded 527, 507.6 , 503 , 522 and 526.2 IU/L respectively.

Table (6): Effect of *Swietenia mahagoni* extracts and oil on urea and creatinine levels of rats

Group	Urea (mg/dl)	Creatinine (mg/dl)
Negative control group	$18^{a} \pm 1$	$0.902^{a} \pm 0.019$
Positive control group	$35.6^{d} \pm 2.3$	$1.136^{d} \pm 0.061$
Methanol extract group	$20.4^{ab} \pm 1.8$	$0.946^{abc} \pm 0.05$
Acetone extract group	$22.6^{bc} \pm 1.14$	$0.93^{ab} \pm 0.015$
Water extract group	$20.6^{ab} \pm 4.4$	$0.938^{abc} \pm 0.03$
Oil group	$23^{bc} \pm 1.58$	$0.956^{bc} \pm 0.02$
Glibenlamide group	$24.8^{c} \pm 1.3$	$0.986^{c} \pm 0.034$

Table (7): Effect of *Swietenia mahagoni* extracts and oil on MDA level and CAT activity of rats

Group	MDA (mg/dl)	Catalase (IU/L)
Negative control group	14.58 ^{a}± 0.835	509 ^{a}± 3.13
Positive control group	16.87 ^{b}± 0.947	539.2 ^{a}± 4.98
Methanol extract group	15.45 ^{ab}± 1.3	527 ^{a}± 5.68
Acetone extract group	16.22 ^{ab}± 1.58	507.6 ^{a}± 2.38
Water extract group	15.78 ^{ab}± 1.55	503 ^{a}± 1.76
Oil group	15.79 ^{ab}± 1.3	522 ^{a}± 3.2
Glibenlamide group	14.86 ^{ab}± 1.58	526.2 ^{a}± 1.58

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بذور الماهوجنى تعالج الفئران المصابة بمرض السكر باستخدام الالوكزان مع حماية الكبد

مصطفى عبدالله همام ، جابر عبدالوهاب خليل ، صلاح منصور السيد ، إبراهيم إبراهيم محمد

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الملخص العربى

تهدف هذة الدراسة إلى دراسة التركيب الكيميائى لبذور الماهوجنى – تركيب الأحماض الدهنية الداخلة فى تركيب الزيت، كذلك تم دراسة تأثير المعاملة بكلا من زيت الماهوجنى والمستخلصات على مستوى سكر الدم . وجد أن بذور الماهوجنى تحتوى على 3.6% رطوبة – 13% بروتين – 62.6% كربوهيدرات كلية – 7.4% ليبيدات – 14% ألياف – 3% رماد. وبتحليل الاحماض الدهنية لبذور الماهوجنى سجل الحمض الدهنى المشبع (C24) lignoceric acid نسبة 38.23 % فى حين سجل حمض (C18) stearic acid نسبة 35.69 % بينما الحمض الدهنى الغير مشبع (C18:2) linoleic acid سجل نسبة 26.08 %. أظهرتحليل المركبات الفينولية بالمستخلص الأسيتونى أن كلا من menthol و nerolidol هى المركبات الاساسية بالمستخلص بنسب 12.32 و 10.06 % على الترتيب 12.32) (respectively % 10.06 and, وأدت معاملة الفئران المصابة بمرض السكرى بمستخلصات وبذور الماهوجنى إلى خفض معنوى فى مستوى سكر الدم كذلك المعاملة أدت إلى خفض معنوى فى نشاط إنزيمات ALP , GPT , GOT وكذلك مستوى اليوريا والكرياتينين و المالونالدهيد وذلك بالمقارنة بمجموعة الفئران المصابة بمرض السكرى..

السادة المحكمين

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