



## Ashwagandha- Update

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### ABSTRACT

*Withania somnifera* (Ashwagandha) is a plant used in medicine from the time of Ayurveda, the ancient system of Indian medicine. Alkaloids (withanolides A, withanolide B, withaferin A) are highly biologically active and possess various therapeutic effects. This review article presents all information on its phytochemical and pharmacological activities. Various therapeutic effects are noted during studies of aswagandha. Some of the studies performed are antioxidant, anxiolytic, adaptogen, memory enhancing, antiparkinsonism, sexual behavior, anti-inflammatory, anti-tumor, anti-arthritis, antibiotic properties.

**KEY WORDS:** Antioxidant, Aswagandha.

### INTRODUCTION:

*Withania somnifera* is a small, woody, tender perennial shrub of solanaceae family that grows 2 feet in height. It is a xerophytic plant, found in the drier parts of India, Sri Lanka, Afghanistan, Baluchistan and Sind and is distributed in the Mediterranean regions, the Canaries and Cape of Good Hope. It is found in high altitude ascending to 5,500 feet in the Himalayas. Two varieties of Asgand have been mentioned in classical Unani literature: 1) Asgand Nagori and 2) Asgand Dakani. Asgand Nagori is preferred for its more potential medicinal properties.<sup>1,2,3,4</sup>

### MORPHOLOGY:

**Roots** - stout fleshy, whitish brown.<sup>5</sup>

**Leaves**- simple ovate, glabrous, in floral region smaller and opposite, dull green in colour, usually upto 10-12 cm.

**Flowers**- inconspicuous, greenish or lubrid-yellow, in axillary, umbellate cymes; small, globose, orange-red when mature, enclosed in the persistent calyx; seeds yellow, reniform.<sup>5</sup>

**Parts used**- Whole plant, roots, leaves, stem, green berries, fruits, seeds, bark are used.<sup>6</sup>

### Taxonomical Classification:

Kingdom: Plantae

Subkingdom: Tracheobionta, Vascular plants.

Division: Angiosperma

Class: Dicotyledoneae

Order: Solanales

Family: Solanaceae

Genus: Withania

Species: *W.somnifera*



**Fig:1 (showing Aswagandha plant)**

**Vernacular classification:**

**Sanskrit:** Ashvagandha, Ash vakandika, Gandhapatri, Palashaparni<sup>7</sup>

**English:** Winter cherry<sup>8</sup>

**Gujrati:** Asan, Asana, Asoda, Asundha Ghodaasod<sup>9</sup>

**Telugu:** Asvagandhi, Penneru, Pennerugadda, Dommadolu

**Phytochemical Constituents:**

**Roots:** It contains alkaloids, aminoacids, steroids, volatile oils, starch, reducing sugars, glycosides, hentriarontane, duleitol, and withanoin.<sup>10,11</sup>

It contains acidic to neutral alkaloids having 0.13-0.31%.

**Basic alkaloids:**It includes cuscohygrine, anahygrine, tropine, pseudotropine, anaferine, isopelletierine, withananine, withananine, pseudo-withanine, somnine, somniferine, somniferine.<sup>10, 11</sup>

**Neutral alkaloids:** It includes 3- tropyltigloate and an unidentified alkaloid. Other alkaloids include withanine, withasomnine, and visamine.<sup>10, 11, 12</sup>

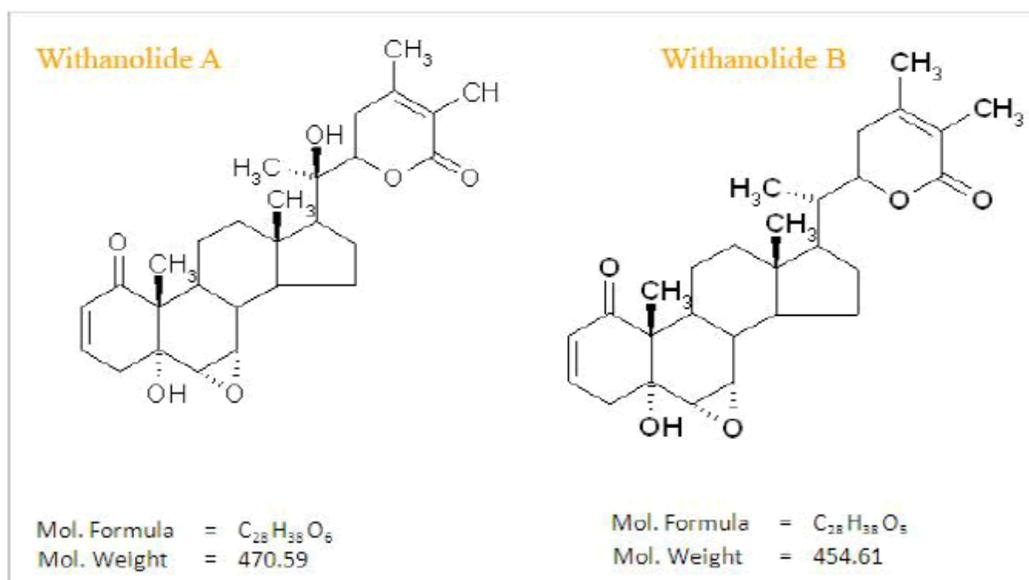
**Leaves:** It contains 12 withanolides, 5 unidentified alkaloids (yield, 0.09%), many free amino acids, chlorogenic acid, glycosides, glucose, condensed tannins, and flavonoids.<sup>10, 11, 12</sup>

**Fruits:** The green berries contain amino acids, a proteolytic enzyme, condensed tannins, and flavonoids. They contain a high proportion of free amino acids which include proline, valine, tyrosine, alanine, glycine, hydroxyproline, aspartic acid, glutamic acid, cystine and cysteine. The presence of a proteolytic enzyme, chamase, in the berries may be responsible for the high content of the amino acid.<sup>10, 11, 12</sup>

**Shoots:** The tender shoots are rich in crude protein, calcium and phosphorous, and are not fibrous. They are reported to contain scopoletin.<sup>10, 11, 12</sup>

**Stem:** It contains condensed tannins and flavonoids.<sup>10, 11, 12</sup>

**Bark:** It contains a number of free amino acids.<sup>10, 11, 12</sup>



**Fig-2: (Active constituents of aswagandha)**

#### THERAPAUTIC USES:

- It is a revitalizing herb that maintains proper nourishment of bones, tissues & muscles.
- It increases resistance to stress.
- It also increases resistance in stress related disorders like arthritis, hypertension, tremors, diabetes, general debility & inflammation.
- It also supports the proper function of adrenals & reproductive system.
- It is also used for treating memory loss.
- It restores neurotransmitters, which helps in various mental disorders.
- Peroxidase is toxic to tissues, hence protective to liver (anti-peroxidase activity).
- It also acts as an anti-aging agent.
- It is a powerful aphrodisiac.
- It is blood tonified, improves circulation & absorption of nutrients from the cells.
- It stimulates thyroid activity.

**Table-1: summary of pharmacological activity of ashwagandha**

S. No	Plant Part	Activity	Extract	Model	Std Drug	Dose	Parameters	Mech.	Stats	P Value	Author & Year
1	Roots	Acute Toxicity	Alcoholic Extract	Acute Toxicity Studies.	Ashwagandha	2000 mg/Kg	Toxic Effects Are Recorded	Hematological And Biochemical Parameters Are Recorded.	-	-	. Singh N, Nath R, Lata A, Singh SP, Kohli RP, Bhargava KP. 1982 <sup>13</sup>
2	Roots & Leaves	Antibiotic Activity	Alcoholic Extract		Pencillin		Inhibition Of Gram-Positive Bacteria, Acid-Fast And Aerobic Bacilli, And Pathogenic Fungi. It Was Active Against Micrococcus Pyogenes Var Aureus And Partially Inhibited The Activity Of Bacillus Subtilis Glucose-6-Phosphatedehydrogenase.	Antibiotic Activity Of Withaferin A Is Due To The Presence Of The Unsaturated Lactone-Ring.	-	-	Anonymous. 1982 <sup>1</sup>



3	Leaf	Anti Inflammatory Activity	Alcoholic Extract	Carrageenan Induced Inflammation, Cotton Pellet Granuloma.			Suppression Of Inflammation.	Release Of Serum B-1 Globulins.	-	-	Anabalagan K, Sadique J. 1985
4	Roots	Fibrosarcoma Tumor	Hydro-Alcoholic Extract	20-Methyl-Cholanthrene Induced Tumor.	20-Methyl-Cholanthrene	-	-	-	-	-	Kulkarni RR, Patki PS, Jog VP 1991 <sup>14</sup>
5	Roots	Anti Convulsant Activity	Root Extract	Pentylene Tetrazole (PTZ)-Induced Convulsion	-	-	Reduces Jerks & Convulsions.	Pentylene Tetrazole (PTZ)-Induced Convulsions Was Recorder By EEG.	-	-	Kulkarni SK, Sharma A, Verma A, Ticku MK 1993 <sup>14</sup>
6	-	Anti Aging Activity	Ashwagandha	Double-Blind Clinical Trial In 59 Aged Males	-	-	Significant Improvement In Hemoglobin, Red Blood Cell Count, Hair Melanin, And Seated Stature. Serum Cholesterol Decreased And Nail Calcium Was Preserved.	Increase In Activity Is Seen.	-	-	Bone K. 1996
7		Immunomodulatory Activity	Indian Ayurvedic Preparation	Myelosuppression Induced By One Or More Of			Hemoglobin Concentration, Red Blood Cell Count, White Blood Cell	Prevents Myelosuppression In Mice Administered		Increase In Hemoglobin Concentration	Mohammed Ziauddin. Et Al. 1996 <sup>27</sup>



				The Following Three Compound s: Cyclophosp hamide, Azathioprin , Or Prednisolon e	-	-	Count, Platelet Count, And Body Weight.	With Ashwagandha.	-	tration (P < 0.01), Red Blood Cell Count (P < 0.01), White Blood Cell Count (P < 0.05), Platelet Count (P < 0.01), And Body Weight (P < 0.05)	
8		Anti Oxidant Activity	Alcoholic Extract	Free Radical Damage By Increased Reactive Oxygen Species.	-	-	Major Free-Radical Scavenging Enzymes, Superoxide Dismutase (SOD), Catalase (CAT), And	Increasing The Enzyme Which Increasing The Anti Oxidant Activity.	-	-	SK Bhattachar ya, KS Satyan, A Chakrabar ti. 1997 15



							Glutathione Peroxidase (GPX) Levels In The Rat Brain Frontal Cortex And Striatum.				
9	Roots	Nootropic Activity	Aqueous, Methanolic Extract	Brain Cholinergic, Glutamatergic And Gabaergic Receptors In Rats	-	-	To Enhance acetylcholinesterase (Ache) Activity In The Lateral Septum And Globus Pallidus, And Decreased Ache Activity In The Vertical Diagonal Band.	M1-Muscarinic-Cholinergic Receptor Binding In Lateral And Medial Septum As Well As In Frontal Cortices, Whereas The M2- Muscarinic Receptor-Binding Sites Were Increased In A Number Of Cortical Regions	-	-	Schliebs R, Liebmann A, Bhattacharya SK, Kumar A, Ghosal SV, Bigl. 1997
10		Anti Hyperglycaemic Activity	Aqueous Extract	Streptozocin (STZ)-Induced Hyperglycaemia In Rats.	-	-	Anti-Hyperglycaemic Effect May Be Due To Pancreatic Islet Free Radical Scavenging Activity	Hyperglycaemic Activity Of STZ Is A Consequence Of Decrease In Pancreatic Islet Cell Superoxide Dismutase (SOD) Activity Leading To The Accumulation Of Degenerative			Bhattacharya SK, Satyan KS, Chakrabarti A. 1997 <sup>15</sup>



								Oxidative Free Radicals In Islet-Beta Cells	-	-	
11	Roots	Anti Oxidant Activity	Aqueous Extract	Stress-Induced Lipid Peroxidation (LPO)	Silymarin	(20 Mg/Kg, P.O.	Hepatic Lipid Peroxidation (LPO), The Serum Enzymes, Alanine Aminotransferase, Aspartate Aminotransferase And Lactate Dehydrogenase, Were Assessed As Indices Of Hepatotoxicity.	Iron Overload Induced Marked Increase In Hepatic LPO And Serum Levels Of The Enzymes,	-	-	Dhuley JN 1998 <sup>19</sup>
12	Leaf	Anti Arthritic Activity	Alcoholic Extract	Adjuvant Induced Arthritis, Formalin Induced Arthritis	Hydrocortisone Sodium Succinate		Suppression Of Inflammation.	Release Of Serum B-1 Globulins.	-	-	Rastogi RP, Mehrotra BN 1998 <sup>28</sup>
13	Leaf	Anti Stress Activity	Alcoholic Extract	Mild Electric Shock Activity	-	-	Stress Inducing Hyperglycemia, Glucose Intolerance, Increase Plasma Corticosterone Levels, Gastric Ulcerations, Male Sexual Dysfunction, Cognitive	Decrease Stress On Electric Shock.	-	-	Dhuley JN. 1998 <sup>19</sup>



							Deficits, Immunosuppression And Mental Depression				
14	Roots	Regulation Of Circulating Thyroid Hormone Concentration In Female Mice.	Alcoholic Extract	Administration Of Withania Somnifera (1.4 G/Kg Body Wt.)	-	-	Circulation Of Thyroid Hormone.	To Maintain Circulation Of Thyroid Hormone.	-	-	S.Panda Et Al. 1999
15	Leaf	Anti Anxiety Activity	Alcoholic Extract	GABA Activity	Lorazepam		Decrease In Neuron Activity, Inhibit Nerve Cells From Activity.	GABA Acts By Inhibitory Activity And Calms.	-	-	Archana R; Namasivayam A 1999 <sup>16</sup>
16	Roots	Regulation Of Lead-Induced Oxidative Damage In Male Mouse	Ethanollic Extract	Lead Toxicity With Special Reference To Lipid Peroxidative Process.	-	-	Lipid Peroxidative Process Has Been Investigated In Liver And Kidney Tissues.	It Significantly Decreased LPO And Increased The Activities Of Antioxidant Enzymes, Viz., Superoxide Dismutase (SOD) And Catalase (CAT), Thus Retaining Normal Peroxidative Status Of The Tissues.	-	-	<a href="#">Shyam Sunder Chaurasia, A.Panda, Anand Kar</a> 2000



17	Roots	Hypolipidemic Activity	Powder	Triton-Induced Hypercholesterolemia	-	-	It Decreases Total Lipids, Cholesterol And Triglycerides In Hypercholesteremic Animals, Increased Plasma HDL-Cholesterol Levels.	It Increases HMG-Coa Reductase Activity And Bile Acid Content Of Liver.	-	-	Andallu B, Radhika B 2000 <sup>31</sup>
18	Roots	Anti Alzheimer's Activity	Alcoholic Extract	Scopolamine Induced Poor Retention By Elevated Plus Maze Task Paradigm.	-	-	Neuronal Dysfunction In Alzheimer's Disease	Reversed Scopolamine-Induced Retention Deficits	-	-	Dhuley JN 2001 <sup>29</sup>
19	Roots	Sexual Behaviour	Methanolic Extract	Treatment With Withania Somnifera For 7 Days.	-	-	It Induces A Marked Impairment In Libido, Sexual Performance, Sexual Vigour, And Penile Erectile Dysfunction.	His Antimale Effect Was Not Due To Changes In Testosterone Levels But Attributed To Hyperprolactinemic, Gabaergic, Serotonergic Or Sedative Activities Of The Extract.	-	-	Ilayperumal I, Ratnasooriya RD, Weerasooriya TR. 2002 <sup>25</sup>



20	Roots	Nootropic Activity	Alcoholic Extract	Induced Neurite Outgrowth In Cultured Rat Cortical Neurons	-	-	Improved Memory Deficits In Abeta-Injected Mice And Prevented Loss Of Axons, Dendrites, And Synapses.	Sominone Induced Axonal And Dendritic Regeneration And Synaptic Reconstruction Significantly In Cultured Rat Cortical Neurons Damaged By Abeta.	-	-	Zhao J, Nakamura N, Hattori M, Kuboyama T, Tohda C, Komatsu K. 2002
21		Anti Carcinogenicity Activity		Urethane-Induced Lung Tumors	-	-	It Decreases The Levels Of The Nuclear Factor Kappab, Suppresses The Intercellular Tumor Necrosis Factor, And Potentiates Apoptotic Signalling In Cancerous Cell Lines	It Reduces The Tumor Size.	-	-	Jayaprakasham B, Zhang Y, Seeram N Nair 2003 <sup>17</sup>
22	Roots	Cytotoxic Properties Against Lung, Colon, Central Nervous System, And Breast	Alcoholic Extract	Nervous System & Breast Cancer Cell Lines.	-	-	The Inhibitory Concentration To Afford 50% Cell Viability (IC50) For These Compounds Was Determined By MTT (3-[4,5-	Withaferin A And Its Derivatives Exhibited Inhibitory Concentrations (50%) Ranging From 0.24 +/- 0.01 To 11.6 +/- 1.9 Microg/ML.	-	-	<a href="#">Jayaprakasham B<sup>1</sup>, Zhang Y, Seeram NP, Nair MG.</a> 2003 <sup>17</sup>



		Cancer Cell Lines					Dimethylthiazol-2,5-Diphenyltetrazolium Bromide) Assay.				
23	Roots	Cardioprotective Activity	Aqueous Extract	Isoprenaline-Induced Myonecrosis In Rats	-	-	Significant Restoration Of Most Of The Altered Haemodynamic And Anti Oxidant Properties.	Antioxidants, Maintenance Of The Myocardial Antioxidant Status	-	-	Mohanty I, Arya DS, Dinda A, Talwar KK, Joshi S, Gupta SK. 2004 <sup>18</sup>
24	Roots	Skin Cancer	Hydro Alcoholic Extract	UV Radiation Induced Skin Carcinoma.			Pretreatment With Withania Somnifera And Exposure To UV Radiation, Inocurance Of Malignancy Is Noted.	Cutaneous Tissues Of Wistar Rats Exposed To UV B Radiation (294 Nm) For 20 Days And Rats Exposed To UV B Radiation For 20 Days, Followed By Topical Treatment With Benzoyl Peroxide, A Tumor Promoter (20 Mg/Animal/0.2 Ml Acetone) Twice A Week For 1 Month,	-	-	Chandra R. 2004 <sup>32</sup>



								And Kept Under Observation For 12 Weeks, Demonstrate The Development Of Malignancy.			
25		Anti Parkansonism Activity	Aqueous Extract	6-Hydroxydopamine (6-OHDA) Induced Parkansonism.			It Is Tested For Neurobehavioral Activity And Were Killed 5 Weeks After Lesioning For The Estimation Of Lipidperoxidation, Reduced Glutathione Content, Activities Of Glutathione-S-Transferase, Glutathione Reductase, GPX, SOD And CAT, Catecholamine Content, Dopaminergic D2 Receptor Binding And Tyrosine Hydroxylase Expression.	6-OHDA Elicits Its Toxic Manifestations Through Oxidant Stress.	-	-	Ahmad M, Saleem S, Ahmad AS, Ansari MA, Yousuf S, Hoda MN, Et Al. 2005 <sup>40</sup>



26	Roots	Skin Carcinogenesis In Mice	Alcoholic Extract	Human Tumor Cell Lines.			Activities Of The Cyt P450 System And Antioxidant Enzymes In Mouse Liver.	It Inhibited Benzo(A)Pyrene-Induced Forestomach Papillomagenesis , Showing Up To 60 And 92% Inhibition In Tumor Incidence And Multiplicity, With Witania Inhibited 7,12-Dimethylbenzanthracene-Induced Skin Papillomagenesis	Analysis Of Variance (ANOVA) Following The Mann-Whitney U-Test	P,0.005	<a href="#">Bandhuvula Padmavathi,Pramod C. Rath, Araga Ramesha Rao,And Rana Pratap Singh 2005</a> <sup>33</sup>
27		Anti Parkinsonism Activity	Aqueous Extract	Neuroleptic-Induced Catalepsy	Reserpine, Haloperidol	-	Reduces Catalepsy Property	It Inhibited Haloperidol Or Reserpine-Induced Catalepsy	-	-	Kumar A, Kulkarni SK 2006
28	Roots	Anti Alzheimer's Activity	Alcoholic Extract	Reserpine Induced Poor Retention By Elevated Plus Maze Task Paradigm.		-	Neuronal Dysfunction In Alzheimer's Disease	Reversed Reserpine-Induced Retention Deficits	-	-	Naidu PS, Singh A, Kulkarni SK 2006



29	Roots	Chondroprotective Activity	Aqueous Extract	Chondroprotective Assay	-	-	Measurement Of PG Levels Secreted By OA Cartilage Explants: Proteoglycan Content Was Measured Spectrophotometrically, Using Dimethylmethylene Blue (DMMB) Dye Binding And CS As Standard	For Each Patient, CM Samples From Control And Drugtreated Explants Were Assayed For PG Content At Each Time Point. Thus, CM From Explants Of Each Patient Were Assayed For Total Pgs At 4 Time Points (Days 2, 4, 6, 8) Post 24-H Treatment With Or Without The Drug.	One Way ANOVA With Student -T Test.	P,0.05	Venil N Sumantrana, Asavari Kulkarnia, Sanjay Boddula, Trushna Chinchwadeb, Soumya J Koppikara, Abhay Harsulkara, Bhushan Patwardhanb, Arvind Choprac And Ulhas V Wagh 2007 <sup>38</sup>	
30	Roots & Leaves	Anti-Malarial	Alcoholic Extract	-	-	-	-	-	-	-	-	Dikasso 2009
31	Roots	Analgesic Effect(Hyperalgesia In DM Neuropathy)	Ethanollic Extract	Effect Of Oral Administration Of Withania Somnifera Root On Formalin-Induced	2.5% Formalin	0.5µl	Nociceptive Scoring Are Calculated.	A Nociceptive Score Was Determined For Each 5 Min Block During That Period By Measuring The Amount Of Time Spent In Each Of	One-Way Analysis Of Variance (ANOVA)	P<0.05	Mohsen Khalili 2009 <sup>37</sup>	



				Pain In Diabetic Rats				The Four Behavioral Categories: 0, The Position And Posture Of The Injected Hind Paw Is Indistinguishable From The Contralateral Paw; 1, Paw Has Little Or No Weight Placed On It; 2paw Is Elevated And Is Not In Contact With Any Surface; 3 The Injected Paw Is Licked, Bitten, Or Shaken.	) Followed By Tuke y's Post-Hoc Test.		
32	Roots	As An Effective And A Novel Source Of Laspariginase	Alcoholic Extract	L-Aspariginase Against Acute Lymphoblastic Leukemia.	-	-	Plant Containing L-Aspariginase With Antitumor Activity.	The Purified L-Aspariginase Was Characterized By Size Exclusion Chromatography, Polyacrylamide Gel Electrophoresis (PAGE), And 2D PAGE.	-	-	<a href="#">Oza VP, Parmar PP, Kumar S, Subramanian RB 2010</a> <sup>34</sup>
33	Roots	Colon Cancer	Alcoholic Extract	Azoxymethane	Azoxymethane	15mg/Kg I.P	Analyzed For TCA Cycle Key	Colon Cancer Was Developed			<a href="#">Muralikrishnan</a>

				Induced & Immune Dysfunction.			Enzymes, Such As Isocitrate Dehydrogenase (ICDH), Succinate Dehydrogenase (SDH), Malate Dehydrogenase (MDH), And Alpha-Keto Glutarate Dehydrogenase (Alpha-KGDH).	By Administering Azoxymethane For 28 Days.	-	-	<a href="#">G, Amanullah</a> , <a href="#">S, Basha MI</a> , <a href="#">Dinda AK</a> , <a href="#">Shak eel F.</a> 2010 <sup>21</sup>
34	Leaf, Roots, Stem	Anti-Proferative Activity(Breast Cancer)	Alcoholic Extract	Human Tumor Cell Lines.	-	-	Growth Inhibition Of PC-3, DU-145 (Prostrate), HCT-15 (Colon), A-549 (Lung) And IMR-32 (Neuroblastoma) Are Noted.	In Vitro Cytotoxicity Against Four Human Cancer Cell Lines Was Determined[Using 96-Well Tissue Culture Plates.	-	-	<a href="#">B. Yadav</a> , <a href="#">A. Bajaj</a> , <a href="#">M. Saxena</a> , And <a href="#">A. K. Saxena</a> 2010 <sup>22</sup>
35	Roots	Paancreatic Cancer	Alcoholic Extract	Pancreatic Cancer Cell Lines	-	-	Efficacy And The Mechanism Of Hsp90 Inhibition Of Withaferin A (WA)	Potent Antiproliferative Activity Against Pancreatic Cancer Cells In Vitro (With IC(50)S Of 1.24, 2.93 And 2.78 Microm) In Pancreatic	-	-	Yu Y, Hamza A, Zhang T, Gu M, Zou P, Newman B, Li Y, Gunatilaka AA,



								Cancer Cell Lines Panc-1, Miapaca2 And Bxpc3,			Zhan CG, Sun D 2010 <sup>20</sup>
36	Leaves	Control Proliferative Cells and Nontoxic To Normal Lymphocytes	Hydro-Alcoholic Extract	Ceramide I nduced Apoptosis.	Ceramide	-	Withad Enhance the Ceramide Accumulation By Activating N-Smase 2, Modulate Phosphorylation Of The JNK And P38mapk And Induced Apoptosis In Both Myeloid And Lymphoid Cells	It Induces Apoptosis In A Dose And Time Dependant Manner Both In Myeloid (K562) And Lymphoid (MOLT-4) Cells Being Nontoxic To Normal Lymphocytes And Control Proliferative Cells.	-	-	Mondal S, Mandal C, Sangwan R, Chandras, Mandal C. 2010 <sup>41</sup>
37	Roots	Dose Dependent Inhibition Of Metastatic Lung Nodules In Breast Cancer Metastasis Mouse Model	Hydro-Alcoholic Extract	Warfarin-A Redues Tumors.	-	-	To Inhibits Breast Cancer Invasion And Metastasis At Sub-Cytotoxic Doses By Inducing Vimentin Disassembly And Serine 56 Phosphorylation	It Induces Perinuclear Vimentin Accumulation Followed by Rapid Vimentin Depolymerization.	-	-	Thaiparambil JT, Bendor L, Ganesh T, Kline E, Patel P, Liu Y, Tighiouart M, Vertino PM, <a href="#">Harvey</a> , <a href="#">Garcia</a>



											<a href="#">a</a> <a href="#">A, Marcus</a> <a href="#">AI</a> 2011 <sup>42</sup>
38	Roots	Adaptogenic	Methanolic Extract	Swim Endurance Test Cold Restraint Stress	-	-	Adaptogens Can Successfully Combat The Negative Effects Of Stress, Improve Health And Well-Being, And Enhance Body's Performance.	The Saponins VII, VIII, IX And X Represent The Adaptogenic Substances Of Withania Somnifera, In Spite Of Diverse Steroidal Structures	One Way ANOVA	P<0.01	Anju 2011
39		Immunomodulatory Activity		Leucopenia Induced By Cyclophosphamide (CTX) Treatment.	Cyclophosphamide, Azathioprine, And Prednisolone.		Significantly Increase Hb Concentration, RBC Count, Platelet Count, And Body Weight In Mice	Increased The Number Of B-Esterase Positive Cells In The Bone Marrow, Reduce Leucopenia Induced By Sub-Lethal Dose Of Gamma Radiation.	-	-	Aggarwal R, Diwanay S, Patki P, Patwardhan B 2012
40	Roots & Leaves	Anti Bacterial Activity	Aqueous Extract	Disc Diffusion Method	Cephalosporin	100mg/Kg	Biochemical, Haematological And Immunological Parameter.	The Animals Are Challenged With Viable E.Coli.	One Way ANOVA Using	P,0.05	Mohamed El-Sayed El-Boshy 2013



									SPSS 20.		
41	Leaves	Antimicrobial Activity	Aqueous, Ethanolica ndacetone Extract	Cup Plate Agar Diffusion Method	Gentamycin	100mg/Kg	Inhibition Of Bacterial Strain Was Detected.	Antimicrobial Activity Was Detected By Measuring The Zone Of Inhibition In Mm Around Each Well, Excluding The Diameter	-	-	Nabeel Al-Ani, Sabreen A. Hadi, Rawaa Nazar 2013
42	Roots	Analgesic Activity	Standardis e Aqeous Extract	Hot Air Pain Model	Withania Somnifera	1000 mg/Kg	Mean Pain Threshold Time At Baseline And 3hrs After Drug Administration Were Noted.	It Is Done By Passing Hot Air And Measuring The Pain Threshold.	-	-	P.Usharani, P.Nalini, K.Manjunath. N. K.Sunil Kumar Reddy. 2013
43	Leaf	Glioprotective Effects Of Ashwagandha Leaf Extract Against Lead Induced Toxicity	Aqeous Extract	Cytoprotective Potential Of Ashwagandha Leaf Aqueous Extract Against Lead Induced Toxicity.	-	-	IC50 And Lead Nitrate Concentration.	ASH-WEX Modulates Lead Induced Morphological Changes As Well As Viability In C6 Glioma Cells.	One Way Anova	P<0.05	Praveen Kumar, Raghavendra Singh, Arshed Nazmi, Dinesh Lakhanpal , Hardeep Kataria, And Gurcharan Kaur 2014 <sup>36</sup>

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