

PLANTS WITH SKELETAL MUSCLE RELAXANT ACTIVITY: A REVIEW

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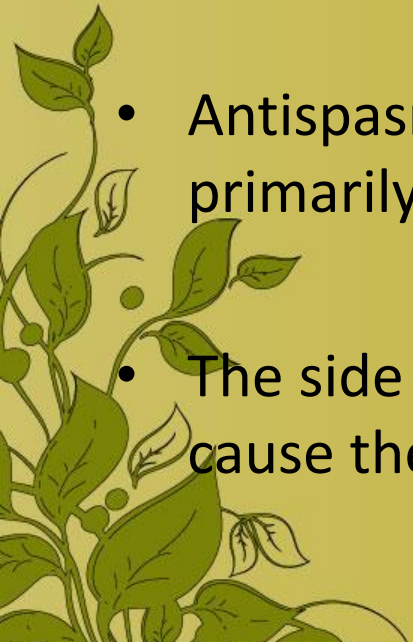


Introduction

- Skeletal muscle relaxants are of two different groups
- Centrally acting muscle relaxants - used to reduce spasticity in a variety of painful conditions (chronic back pain and painful fibromyalgic conditions)
- Neuromuscular blockers -used during surgical procedures and in the intensive care unit (ICU) to produce muscle paralysis



- Skeletal muscle relaxants are used to treat muscle spasm and spasticity.
- Muscle sprains & muscle strains.
- The antispasticity agents baclofen, tizanidine, dantrolene, and diazepam-aid in improving muscle hypertonicity and involuntary jerks.
- Antispasmodic agents, such as cyclobenzaprine, are primarily used to treat musculoskeletal conditions.
- The side effects of antispasmodic & antispasticity agents cause them to be used with caution



Viola Betonicifolia



- ❑ Common Name
 - ✓ Arrowhead violet,
 - ✓ Showy violet,
 - ✓ Mountain violet

- ❑ Traditional use
 - ✓ Epilepsy, insomnia, astringent, antipyretic, purgative
 - ✓ Roots & flowers used in asthma, cough & cold

- ❑ Other activity
 - ✓ anxiolytic, sleep induction analgesic, antipyretic, anti inflammatory, anti convulsant

- ❑ Part used for SMR activity
 - ✓ Whole plant
- ❑ Extraction: Methanol; Maceration
- ❑ Active principal: 4HC
- ❑ Animal used:
 - ✓ Albino mice
- ❑ Animal Models used
 - ✓ Traction test
 - ✓ Chimney test

- ❑ Dose: VBME-300,400,500mg/kg i.p
4HC-10,20,30mg/kg i.p

- ❑ Possible MOA:
Centrally acting skeletal
muscle relaxant activity by
interfering with GABA_A complex.



Effects of VBME (%) on muscle relaxation (Chimney test and Traction test).

Group	Dose/kg	Chimney test (%)			Traction test (%)		
		30 min	60 min	90 min	30 min	60 min	90 min
Control	10 mL	0 ± 0.00	0 ± 0.00	0 ± 0.00	0 ± 0.00	0 ± 0.00	0 ± 0.00
Diazepam	1 mg	100 ± 0.00***	100 ± 0.00***	100 ± 0.00***	100 ± 0.00***	100 ± 0.00***	100 ± 0.00***
	0.3 g	10.12 ± 0.88	14.11 ± 0.97	11.09 ± 2.11	12.54 ± 1.10	15.23 ± 2.13	10.34 ± 1.90
VBME	0.4 g	55.13 ± 1.23*	61.56 ± 0.65*	58.23 ± 0.56*	65.02 ± 0.23*	72.12.04 ± 0.56*	68.04 ± 0.34*
	0.5 g	77.08 ± 0.11**	80.76 ± 0.02**	80.55 ± 0.21**	75.05 ± 0.12**	78.03 ± 0.08**	77.67 ± 0.00**

Effects of 4HC (%) on muscle relaxation (Chimney test and Traction test).

Group	Dose/kg	Chimney test (%)			Traction test (%)		
		30 min	60 min	90 min	30 min	60 min	90 min
Control	10 mL	0 ± 0.00	0 ± 0.00	0 ± 0.00	0 ± 0.00	0 ± 0.00	0 ± 0.00
Diazepam	1 mg	100 ± 0.00***	100 ± 0.00***	100 ± 0.00***	100 ± 0.00***	100 ± 0.00***	100 ± 0.00***
	10 mg	0 ± 0.00	0 ± 0.00	0 ± 0.00	0 ± 0.00	0 ± 0.00	0 ± 0.00
4HC	20 mg	15.13 ± 1.34*	20.21 ± 1.35*	20.45 ± 0.44*	4.50 ± 1.67*	6.55 ± 1.22*	3.54 ± 1.89*
	30 mg	30.34 ± 1.54**	37.33 ± 1.57**	35.45 ± 1.45**	25.34 ± 0.23**	27.04 ± 1.77**	26.78 ± 2.56**

Vicia Faba



- ❑ Common Name
 - ✓ Fava bean,
 - ✓ Broad bean,
 - ✓ Bell bean
 - ✓ Field bean, tic bean

- ❑ Traditional use
 - ✓ As Food

- ❑ Other activity
 - ✓ anti-parkinsonian



- Part used for SMR activity
 - ✓ Leaves, Seeds
- Extraction: Methanol; Soxhlet
- Phytochemicals: Tanins, saponins, steroids, alkaloids
- Animal used:
 - ✓ Albino mice
- Animal Models used
 - ✓ Rotarod



- Dose: VFME 400mg/kg p.o.
leaves + seeds 600mg/kg p.o.

- Possible MOA: -



(CONTROL: DISTILLED WATER)

S.NO	BODY WEIGHT(g)	BODY WEIGHT(g)	VOLUME OF DISTILLED WATER TO BE ADMINISTERED (ml)	FALL OFF TIME IN SECONDS
1	22	8.8	0.22	19
2	23	9.2	0.23	07
3	22	8.8	0.22	09

AVERAGE – 11.6 (Sec)

(TEST: METHANOLIC EXTRACT 400mg/kg)

S.NO	BODY WEIGHT(g)	DOSE (mg/kg)	VOLUME OF EXTRACT TO BE ADMINISTERED (ml)	FALL OFF TIME IN SECONDS
1	22	8.8	0.22	06 ±0.14***
2	27	10.8	0.27	05±1.04
3	21	8.4	0.21	02±0.74*

AVERAGE – 4.33 (Sec)

(STANDARD: DIAZEPAM 4mg/kg)

S.NO	BODY WEIGHT(g)	DOSE (mg/kg)	VOLUME OF SELINE TO BE ADMINISTERED (ml)	FALL OFF TIME IN SECONDS
1	21	0.084	0.21	04±0.61***
2	24	0.096	0.24	02±0.15**
3	20	0.080	0.20	02±0.42*

AVERAGE – 2.66 (Sec)

Tridax procumbens



❑ Common Name

- ✓ Coat buttons,
- ✓ Mexican daisy,
- ✓ Hindi: Gavpattha
- ✓ Telugu:
Ravanasuruditalakai

❑ Traditional use

- ✓ Bronchial catarrh,
dysentery, diarrhoea,
restoring hair

❑ Other activity

- ✓ Wound healing, anti
microbial, anti diabetic,
hepatoprotective



Part used for SMR activity

✓ Leaves

Extraction: Aqueous; (Maceration; Percolation)

Phytochemicals: luteolin, quercetin, glucoluteolin, isoquercetin

Animal used:

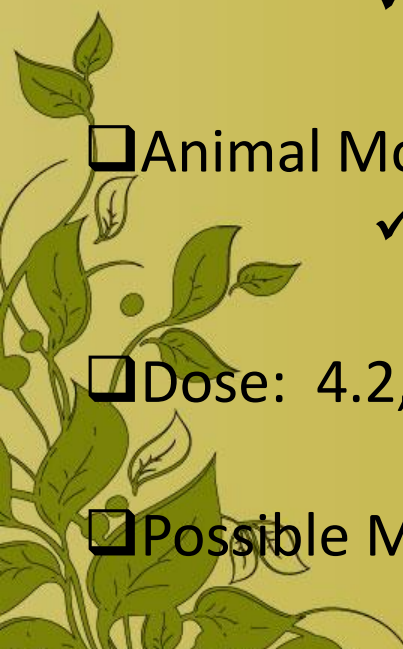
✓ Albino mice & wistar rats

Animal Models used

✓ Rotarod/ Inclined plane.

Dose: 4.2, 8.2 & 12.6mg/kg i.p

Possible MOA: -



Effect of aqueous extract of TP on muscle grip strength using Rota rod

Treatment (mg/kg) (i.p.)	Fall off time (sec)		% Decrease
	Before	After	
Diazepam (0.3)	67.4±3.53	11.2±3.08***	79.4±3.17
<u>TP (4.2)</u>	63.6±2.94	23.2±1.14***	<u>66.8±2.47</u>
TP (8.4)	115.8±1.53	68.6±3.17***	41.2±3.21
TP (12.6)	54±2.38	35.4±3.82***	38.8±1.39



Senna occidentalis



- ❑ Common Name
 - ✓ Stinking weed,
 - ✓ Coffee senna,
 - ✓ Coffee weed

- ❑ Traditional use (powdered leaves)
 - ✓ Analgesic, antimicrobial, Insecticidal, febrifuge, vermifuge, purgative, epilepsy

- ❑ Other activity (leaves)
Anti carcinogenic, anti mutagenic, anti inflammatory, anti rheumatic, anti plasmodial.

- Part used for SMR activity
 - ✓ Seeds
- Extraction: Ethanol; Maceration
- Phytochemicals: Anthraquinones, cardiac glycosides, alkaloids, saponins, tannins, flavanoids.

- Animal used:
 - ✓ Wistar rats
- Animal Models used
 - ✓ Rotarod
 - ✓ Actophotometer

- Dose: 50, 100, 200mg/kg p.o
- Toxicity study: LD₅₀ :3250mg/kg bw
- Possible MOA:



Effects of ESESO on Skeletal Muscle Relaxant Activity in Wistar Rats

S.No	Treatment	Dose (mg/kg)	Mean fall-off time in min			% Decrease in fall-off time in 10 mints	
			Before Treatment	After Treatment		After	After
				30	60	30	60
1	Diazepam	4	15.23±2.14	4.01±0.76*	2.83±0.45*	73.67	81.42
2	ESESO	250	14.13±3.88	4.13±0.65*	7.76±0.80*	<u>70.79</u>	<u>69.27</u>
3	ESESO	500	13.80±1.34	4.26±0.79*	5.80±0.96*	69.13	57.97

Saraca indica



- ❑ Common Name
 - ✓ Ashoka
 - ✓ Sita ashoka

- ❑ Traditional use
 - ✓ Digestion, Antimicrobial, Astringent, Menorrhagia.

- ❑ Other activity
 - ✓ CNS depressant, diuretic, antimicrobial, cytotoxic, oxytocic, antiulcer, antidiabetic, antioxidant



Part used for SMR activity

✓ Leaves

Extraction: Methanol;
soxhlet

Phytochemicals: Flavanoids,
saponins, triterpinoids, tanins,
glycosides, steroids, alkaloids.

Animal used:

✓ Albino mice

Animal Models used

✓ Rotarod

Dose: 200mg/kg p.o.

Possible MOA: Flavanoids , saponins
& triterpinoids are thought to
potentiate GABAergic inhibition.



Effect of Methanolic Extract of *Saraca indica* Linn. on Mice by Rotarod Method.

S.No	Treatment	Dose mg/kg body weight	Locomotion test
1	Control (Distilled water)	5ml/kg	93.35±4.07
2	Diazepam	4	50.86±2.88 ^{***}
3	Methanolic Extract	200	74.75±1.73 ^{**}
4	P value		<0.0001
5	F value		48.69



Parthenium hysterophorus



- ❑ Common Name
 - ✓ Congress grass

- ❑ Traditional use
 - ✓ Tonic, febrifuge, emmenagogue, analgesic in neuralgia.
 - ✓ Root decoction used for dysentery.

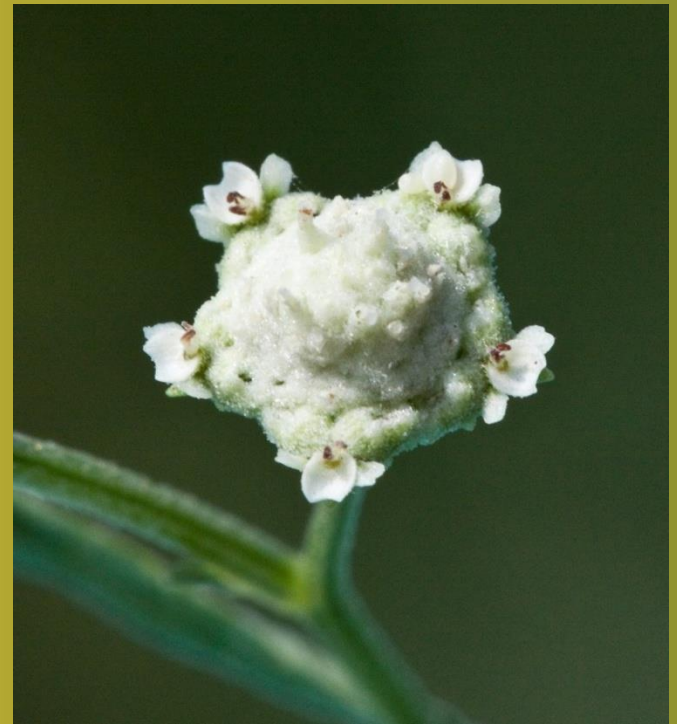
- ❑ Other activity: Antiamoebic, antitumor, trypanocidal, antimalarial



- Part used for SMR activity
 - ✓ Leaves
- Extraction: Methanol; Soxhlet
- Phytochemicals: anthraquinones, saponins, steroids, tanins, reducing sugars

- Animal used:
 - ✓ Albino mice
- Animal Models used
 - ✓ Rotarod
 - ✓ Traction test

- Toxicity study: LD₅₀ 50-300mg/kg
- Dose: 3, 5mg/kg p.o
- Possible MOA: Depolarizing neuromuscular junction blocking effect



DURATION OF TIME SPEND ON ROTAROD

Group	Dose	0 minutes	30 minutes
Control	Saline soln.	328.17 ± 1.62	322.7±24.85
Diazepam	10 mg/kg i.p.	340.50 ±18.93	104.8±2.85**
MEPH	5 mg/kg p.o.	342.23 ±18.60	189.5±41.57*
MEPH	3mg/kg p.o.	342.50 ±12.23	201.00±32.45*



Nerium oleander



- ❑ Common Name
 - ✓ Kaner, Arali
- ❑ Potentially toxic in all parts
- ❑ Traditional use
 - ✓ Variety of skin disorders, herpes, leprosy, tumors, abortifacient
 - ✓ Leaves: cardiotonic, antibacterial, cutaneous eruptions, diuretic, snakebite
- ❑ Other activity: Anti tumor, inhibit FGFR2

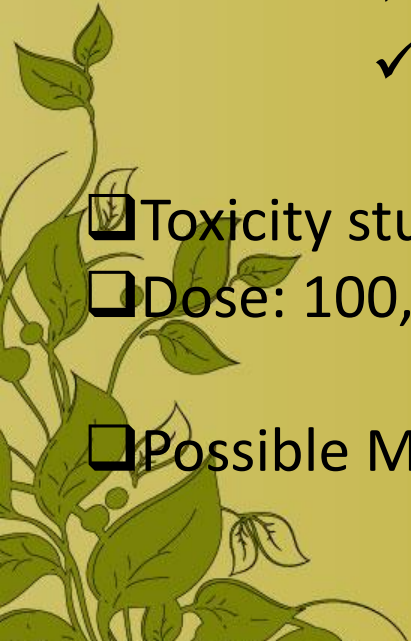


- Part used for SMR activity
 - ✓ Leaves, flower
- Extraction: Aqueous; Soxhlet
- Phytochemicals: anthraquinones, saponins, steroids, tanins, flavonoids

- Animal used:
 - ✓ Albino rats
- Animal Models used
 - ✓ Rotarod
 - ✓ Actophotometer

- Toxicity study: safe upto 2000mg/kg
- Dose: 100, 200mg/kg p.o

- Possible MOA: Augmenting GABA, CNS depressant action.



Effect of AENOF on locomotor activity in actophotometer and muscle coordination on the Rotarod apparatus

Group (n=5)	Actophotometer score in 5 min before	After 60 min of administration	Percentage of reduction	Time spent on revolving rod in Rotarod apparatus (s)
Group I (control) -NS 10 ml/kg	153.2±2.58	-	0	318±17.72
Group II (standard) -Diazepam 10 mg/kg	217.8±7.67	13.33±2.17**	93.87	15.17±2.24**
Group-III -AENOF 100 mg/kg	194.5±4.66	41±1.58**	78.86	186.8±8.04**
Group-IV -AENOL 200 mg/kg	180±5.78	25.4±2.07**	86.11	35.4±3.84**

**P<0.000, All values are expressed as mean±SD. SD=Standard deviation, AENOF=Aqueous extract of *Nerium Oleander* flowers

Effect of AENOF on locomotor activity in actophotometer after giving the extract directly into the muscle

Group (n=3)	Actophotometer score before 5 min	Actophotometer score after 5 min	After 30 min of administration	Percentage of reduction after 30 min	P
Group I (control) -distilled water 10 ml/kg	167.2±3.38	166.8±3.32	164.6±3.28	1.55	0.613
Group-II -AENOF 100 mg/kg	191.8±4.36	190.2±4.29	188.8±4.20	1.57	0.706
Group-III -AENOL 200 mg/kg	182.1±4.19	180.8±4.06	179.1±3.92	1.65	0.680

P>0.05, all values are expressed as mean±SD. SD=Standard deviation, AENOF=Aqueous extract of *Nerium Oleander* flowers

Cinnamomum zeylanicum



- Common Name
 - ✓ Cinnamon

- Traditional use
 - ✓ Cookery-condiment
 - ✓ Musculoskeletal disorders
 - ✓ Cinnamon oil used for cold flu, aching muscles.

- Other activity:
 - ✓ Nrf2 – ARE pathway-Antioxidant action.
 - ✓ Anti melanoma activity.
 - ✓ NFKB/ NF-KB

- Part used for SMR activity
 - ✓ Bark (Inner bark)
- Extraction: Aqueous; Soxhlet
- Phytochemicals: volatile oils, cinnamonaldehyde, eugenol, transcinnamic acid, proanthocyanidins

- Animal used:
 - ✓ Albino rats
- Animal Models used
 - ✓ Rotarod
 - ✓ Actophotometer

- Toxicity study: safe upto 2000mg/kg
- Dose: 50,100, 200mg/kg p.o

- Possible MOA: -



Effect of AECZB on the locomotor activity on the actophotometer and muscle Coordination on the rotarod apparatus

Groups	Actophotometer score			Time spent on revolving rod in Rotarod apparatus (in seconds)
	5 minutes Before administration	60 minutes after administration	% of Reduction	
Group I (control) NS 10 ml / kg	158.3 ± 60.89	----	0	99.67 ± 1.74
Group II (standard) Diazepam 10 mg / kg	215.7 ± 70.12	<u>9.33 ± 8.45^{***}</u>	96.06	<u>12 ± 0.73^{**}</u>
Group-III AECZB 50 mg / kg	163.5 ± 1.72	45.5 ± 1.25 ^{***}	72.39	82.17 ± 0.60 [*]
Group-IV AECZB 100 mg / kg	203.2 ± 1.79	32.83 ± 1.30 ^{***}	83.85	30.33 ± 1.20 ^{**}
Group-V AECZB 200 mg / kg	193.5 ± 1.60	<u>14.67 ± 1.06^{***}</u>	92.41	<u>19.17 ± 0.60^{**}</u>

AESCZB-Aqueous extract of *S Cinnamomum Zeylanicum*. All values are Mean ± SD, n = 6, *P < 0.05, **P < 0.01, ***P < 0.000 when compared with the control

Hibiscus rosa-sinensis



Common Name

- ✓ Red hibiscus
- ✓ China rose
- ✓ Japapushpam

Traditional use

- ✓ Hair care preparation
- ✓ Shoe shining
- ✓ Anti solar agent

Other activity: Abortifacient, Dentifrice, expectorant, antipyretic, anti inflammatory, analgesic, anti estrogenic.



Part used for SMR activity

✓ Leaves

Extraction: Methanol; Soxhlet

Phytochemicals: Flavanoids (hibiscitin), phenolic content, terpenoid like sitosterol, campesterol

Animal used:

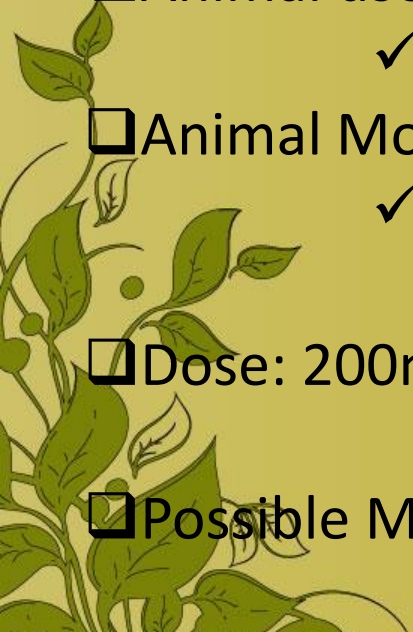
✓ Albino rats

Animal Models used

✓ Rotarod

Dose: 200mg/kg p.o

Possible MOA: -



Skeletal Muscle Relaxant effect of MEHR on rat using Rota-rod model

For Skelatal muscle relaxant: Rota rod model (time required to fall down)

Sr. No.	Group	Control (seconds)	Standard (seconds)	Test (seconds)
1	Head	240	5	17
2	Tail	250	6	15
3	Back	260	8	21
4	head tail	250	5	17
5	back tail	240	7	18
6	No mark	240	4	17
Average		246.66	5.83	17.5
SD		8.16	1.47	1.97
SEM		3.34	0.60	0.80
variance		66.66	2.16	3.9



Mikania scandens



- ❑ Common Name
 - ✓ Climbing hempwood
 - ✓ Climbing hempvine
 - ✓ Louse plaster

- ❑ Traditional use
 - ✓ Cover crop, livestock fodder, butterfly garden
 - ✓ Gastric ulcer, wounds, Insect bites & stings





Part used for SMR activity

✓ Ariel parts

Extraction: Hydroalcoholic .

Phytochemicals: flavonoids,
steroids, tanins, saponins,
sugar



Animal used:

✓ Albino mice

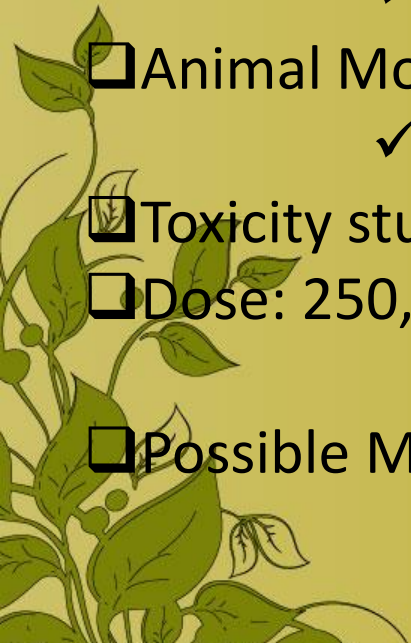
Animal Models used

✓ Rotarod

Toxicity study : safe upto 2000mg/kg p.o

Dose: 250, 500mg/kg i.p

Possible MOA: -



Effect of HAMS on muscle relaxant activity in mice

Treatment	Dose (mg/kg)	Mean fall off time (seconds)			% decrease in fall off time	
		Before treatment	After treatment		After 30 min	After 60 min
			30 min	60 min		
Diazepam	4	15.23 ± 2.14	4.01 ± 0.76*	2.83 ± 0.45*	73.67	81.42
HAMS	250	14.13 ± 3.88	4.13 ± 0.65*	7.76 ± 0.80*	70.77	45.08
HAMS	500	13.80 ± 1.34	4.26 ± 0.79*	5.80 ± 0.94*	69.13	57.97

Data are expressed as mean ± SEM (n=6); *P<0.001 compared with control (mice before treatment), assessed by paired Student's 't' test

Moringa oleifera



❑ Common Name

- ✓ Drumstick tree
- ✓ moringa
- ✓ Horse radish tree

❑ Traditional use

- ✓ Purification of water
- ✓ Handwashing
- ✓ Forage for livestock
- ✓ anthelminthic



❑ Other activity: Anti inflammatory, antioxidant, antimicrobial, hypocholesterol, antiobesity, CNS depressant action



Part used for SMR activity

✓ Leaves

Extraction: Ethanol ; Soxhlet

Phytochemicals: Flavonoids
saponins, tanins, phenolic acids.

Animal used:

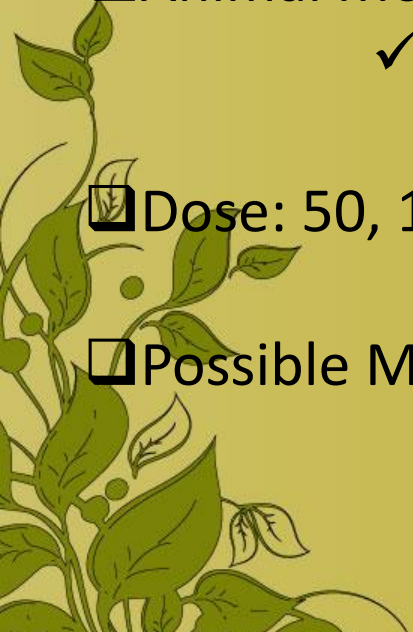
✓ Albino rats

Animal Models used

✓ Rotarod

Dose: 50, 100, 200, 400mg/kg p.o

Possible MOA: -



- EEMO showed significant ($p < 0.05$) progressive decrease in time of fall from rotarod with increase in dose.



Phyllostachys bambusoides



- ❑ Common Name
 - ✓ Giant timber bamboo
 - ✓ Japanese timber bamboo

- ❑ Traditional use
 - ✓ Anti inflammatory,
 - ✓ Anti pyretic,
 - ✓ diuretic

- ❑ Other activity: Hypertension, antioxidant, antimicrobial, anticancer
Used for treating cardiovascular disorders & arteriosclerosis.



Part used for SMR activity

✓ Leaves

Extraction: Chloroform; Soxhlet

Phytochemicals: Flavanoids
glycosides, tannins, proteins,
carbohydrates

Animal used:

✓ Wistar rats

Animal Models used

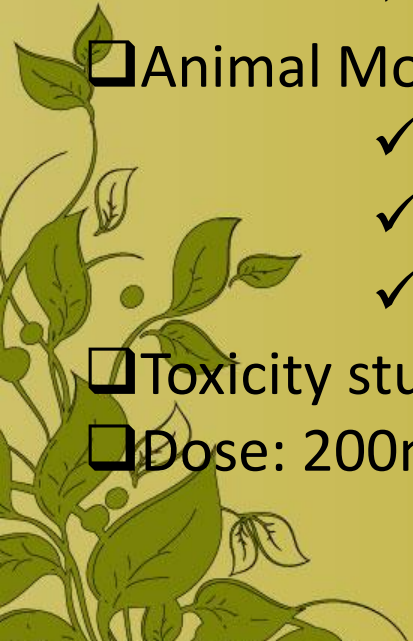
✓ Rotarod

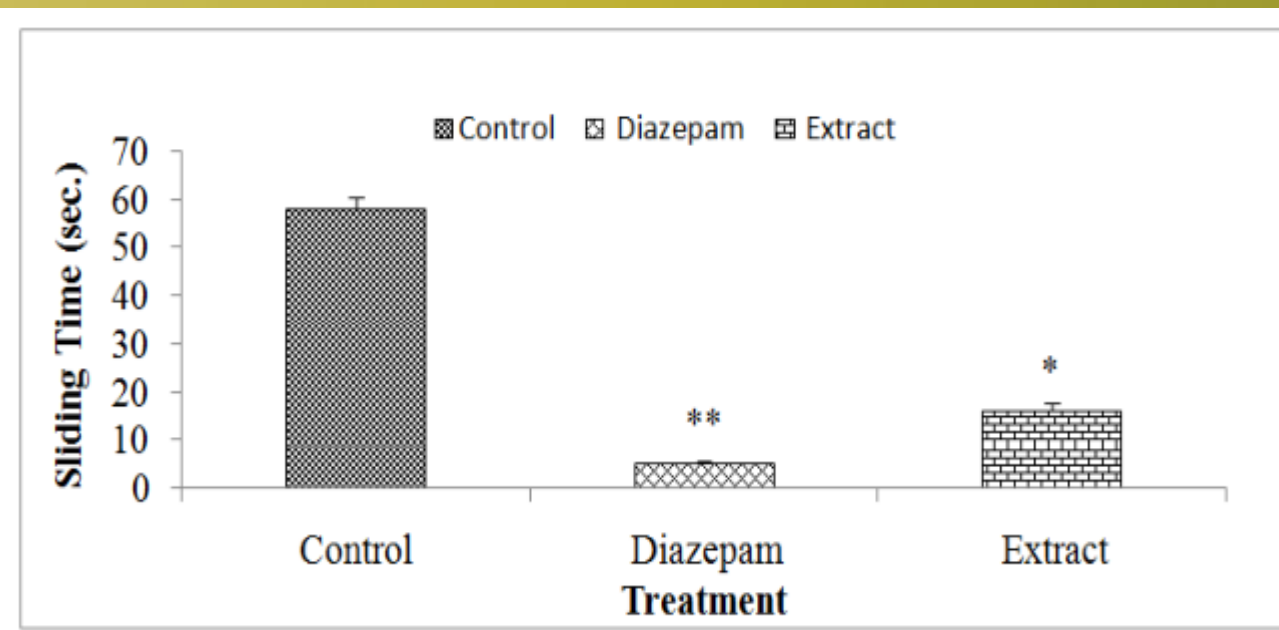
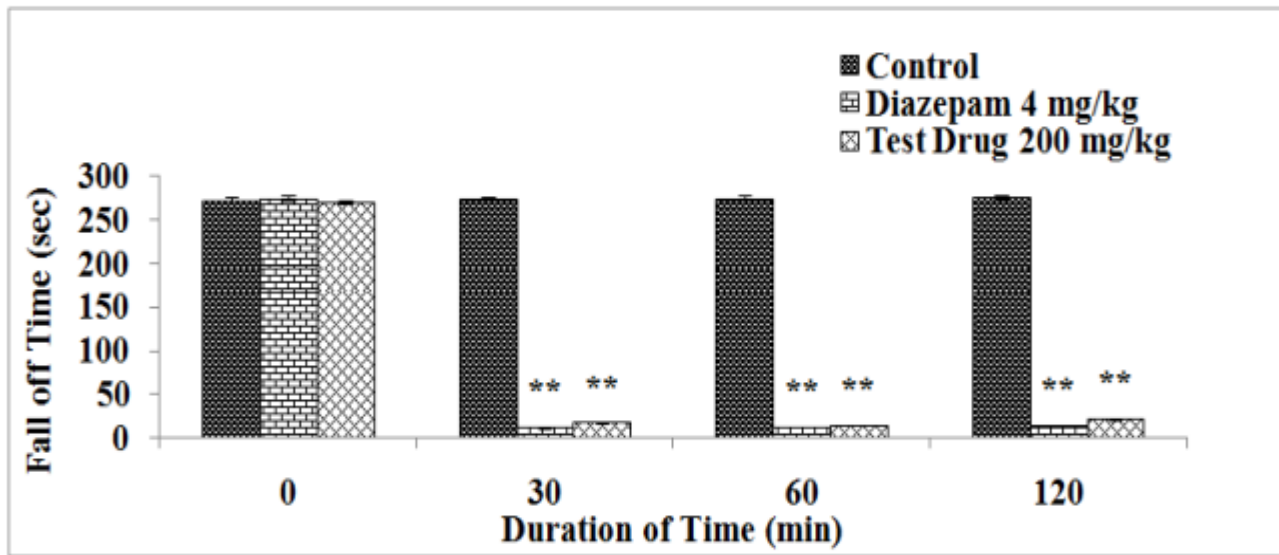
✓ Inclined screen test

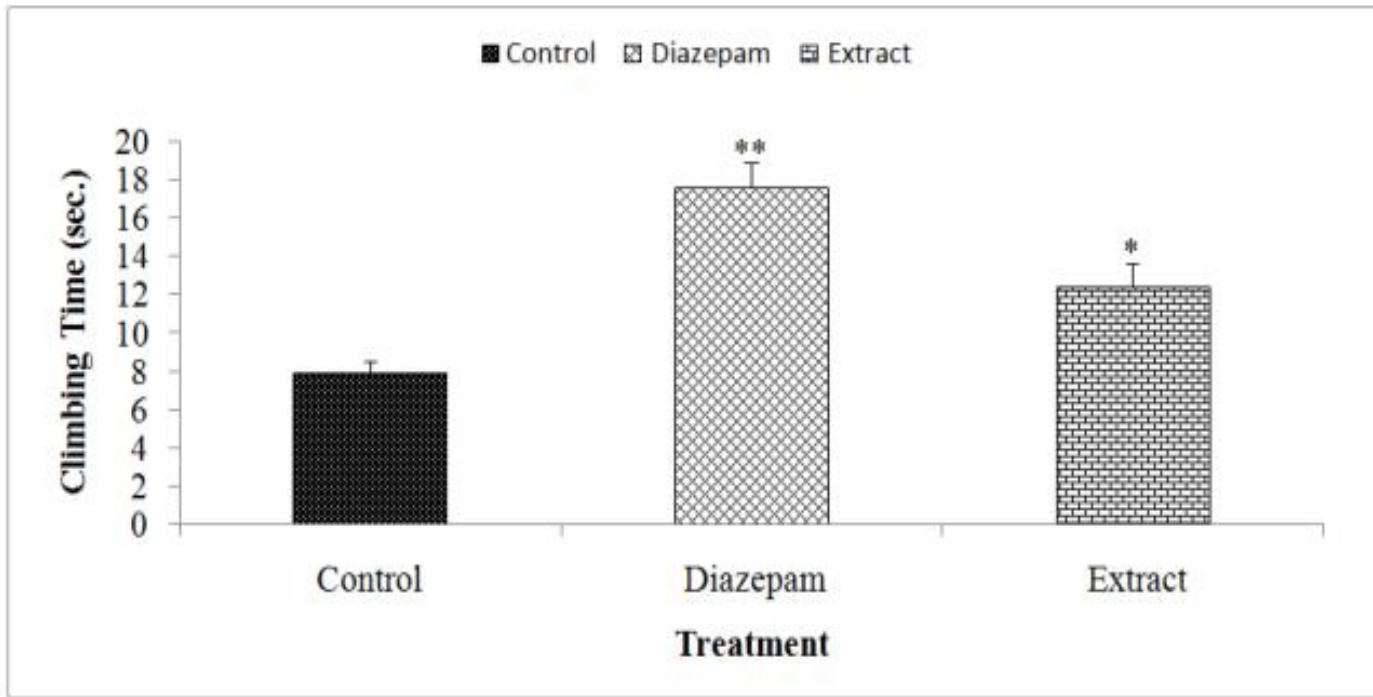
✓ Climbing test

Toxicity studies: toxicity at 2000mg/kg p.o

Dose: 200mg/kg p.o







Sapindus trifoliatus



❑ Common Name

- ✓ Soap nut
- ✓ Soap berries
- ✓ Ritha/ reetha, phenil

❑ Traditional use

- ✓ Fruits/ berries natural surfactant-soap, kill lice
- ✓ Spermicidal, emetic, expectorant, epilepsy

❑ Other activity: antiepileptic, used in migraine.



Part used for SMR activity

✓ Pericarp

Extraction: Aqueous; Soxhlet

Phytochemicals: Saponins, anthraquinones, tannins, isoflavanoids

Animal used:

✓ Albino mice

Animal Models used

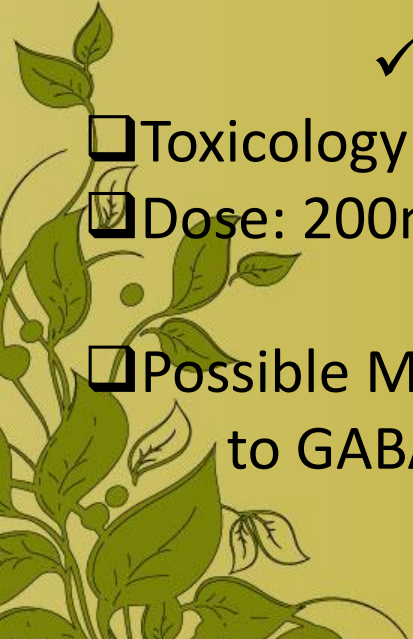
✓ Rotarod

✓ Actophotometer

Toxicology: non toxic upto 2000mg/kg p.o

Dose: 200mg/kg p.o

Possible MOA: -Possibly Isoflavanoids bind to GABA/BZD receptor complex in brain.



Effect of AEST on locomotor activity in actophotometer and muscle coordination in rotarod apparatus

Groups n =10	Actophotometer score in 5 min before	After 60 min of administration	% of Reduction	Time spent on revolving rod in rotarod apparatus(sec)
Group I(control) NS 10ml/kg	158.3 ± 60.89	----	0	100 ± 10.54
Group II(standard) Diazepam10mg/kg	215.7 ± 70.12	9.33 ± 8.45***	96.06	12.2 ± 3.58**
Group-III AEST 50mg/kg	165.3 ± 13.98	47.33 ± 9.13***	71.37	82.8 ± 22.14*
Group-IV AEST 100mg/kg	218 ± 25.04	33 ± 22.57***	85.11	32.3 ± 15.07**
Group-V AEST 200mg/kg	198.3 ± 76.2	14.67±14.14***	87.73	20.3 ± 2.94**

AEST-Aqueous extract of *Sapindus trifoliatus*. All values are Mean±SD, n = 10, *P<0.05, **P<0.01, ***P<0.000 when compared with control.

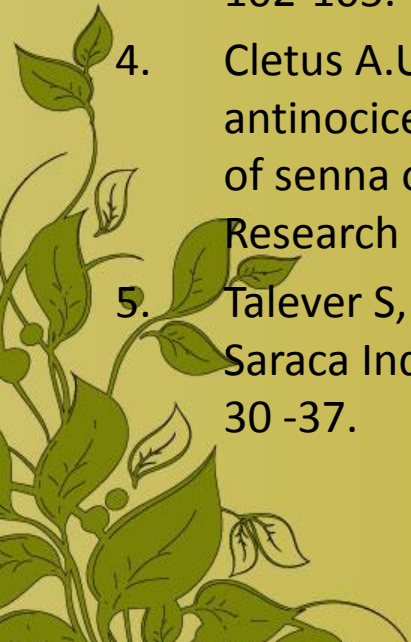
Conclusion

- Many traditional plants with significant SMR activity.
- Traditional medicine--screening and bio prospecting large number of new drug leads.
- Active principle and its mechanism of action.
- More studies needed in this direction.

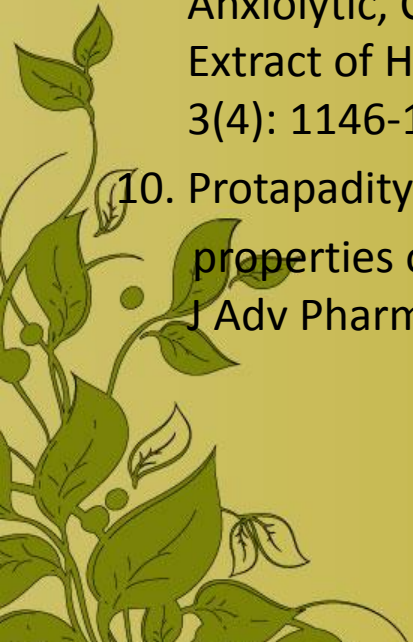


References

1. Naveen M, Mohammad S, Harron K, Achyut A and Khalid MK. Muscle Relaxant and Sedative-Hypnotic Activities of Extract of *Viola betonicifolia* in Animal Models Supported by Its Isolated Compound, 4-Hydroxy Coumarin. *Journal of Chemistry* 2013; Vol 2013:p 1-6.
2. Kalakonda R and Kaidiri SK. Screening of skeletal muscle relaxant activity of plant *vicia faba*. *Int J Pharm* 2013; 4(1):p 237-40.
3. Kumbhar S.P, More R.R, Burande M.D, Waghmare P.V. Evaluation of Skeletal Muscle Relaxant Activity of *Tridax procumbens* Linn. in Mice and Rat. *International Journal of Toxicological and Pharmacological Research* 2014; 6(4):p 102-105.
4. Cletus A.U, Francis J.I, Monday I.E, Didigwu J.C, Nathaniel S.M. Investigating antinociceptive and skeletal muscle relaxant properties of Ethanol seed extract of *senna occidentalis* linn. (Fabaceae) in wistar rats. *International Journal of Research in Pharmaceutical and Nano Sciences* 2013; 2(4):p 485 - 494.
5. Talever S, Snigdha G, Milind P, Akansha S. Neuropharmacological Screening of *Saraca Indica* leaves. *Guru Drone Journal of Pharmacy and Research* 2014; 2(2): p 30 -37.



6. Urmilesh J, Prites J.C, Rajesh J.O and Tushar T.S. Skeletal muscle relaxant activity of methanolic extract of *Parthenium hysterophorus* L. leaves in swiss albino mice. *International journal of pharmacy & life sciences* 2011; Vol 2(11):p 1211-13.
7. Jayasree T, Maulik P, Ubedulla S, Harini K and Shankar J. Evaluation of skeletal muscle relaxant activity of aqueous extract of *Nerium oleander* flowers in Albino rats. *Indian J Pharmacol* 2015;47:409-13.
8. Jayasree T, Kavitha R, Chandrasekhar N, Saequa S. Evaluation of centrally acting skeletal muscle relaxant activity of aqueous extract of *Cinnamomum zeylanicum* bark in albino mice 2012; Vol1(2): 94-8.
9. Ganatra TH, Joshi UH, Patel MN, Desai TR and Tirgar PR. Study of Sedative, Anxiolytic, CNS – Depressant and Skeletal Muscle Relaxant Effects of Methanolic Extract of *Hibiscus Rosa-Sinensis* on Laboratory Animals. *J Pharm Sci & Res.* Vol 3(4): 1146-1155.
10. Protapaditya D, Sangita C, Priyanka C, Sanjib B. Neuropharmacological properties of *Mikania scandens* (L.) Willd (Asteraceae). *J Adv Pharm Technol Res* 2011; Vol 2(4): 2559.



THANK YOU

