2. REVIEW OF LITERATURE

_Salvadora persica_ is a small tree or shrub with a crooked trunk, seldom more than one foot in diameter. Its bark is scabrous and cracked, whitish with pendulous extremities. The root bark of the tree is similar to sand, and the inner surfaces are even lighter shade of brown. It has a pleasant fragrance, as well as a warm and pungent taste. It sheds its leaves from late December to January. The leaves break with a fine crisp crackle when the foot falls over them. In Pakistan these ancient, majestic and sturdy trees are more closely associated with graveyards like the cypress tree in English culture.²³

2.1. Traditional and medicinal uses²⁴

The plant is mentioned in holy Quran and Sonnah, and the roots and shoot sticks have been used for centuries as oral hygiene tools in many parts of the world. It was reported that fresh and dried leaves, dried fruits and stems are used to treat swellings, ulcers and blisters, scorpion stings, regulating menstruation, gases and worms. In UAE (United Arabic Emirates) the roots used as toothbrushes and the crushed leaves used with oil to treat joint and knee pains while the fruits also are edible.

Fruits edible and used as a carminative, anthelmintic, vulnerary, stomachic, antiseptic and anti inflammatory and good for spleen, gum, scabies, syphilis, gonorrhea and as appetizer. Fruits possess deobstruent, diuretic, lithontriptic and are used in biliousness and rheumatism.

The leaves are bitter, corrective, deobstruent, astringent to the bowels, tonic to the liver, diuretic, analgesic, anthelmintic, useful in ozena and other nose troubles, in piles, scabies, leucoderma, lessen inflammation and strengthen the teeth. Leaves and flowers used for toothache, gum problems, joint pains, skin diseases, snake bites, kidney stones, constipation, carminative and anthelmintic. The plant browsed by sheeps and goats and the leaves used as fodder and a purgative for camels. Also the plant has been incorporated into commercially available toothpaste. Dried leaves in small doses are given with copious amount of water for treatment of flatulent dyspepsia.
Fresh root bark is used as a vesicant and is employed as an ingredient of snuff. A paste of the root is applied as a substitute of mustard plaster and their decoction is used against gonorrhea. The extract of the root is used to relieve the pain due to spleen troubles. A decoction of the bark is used as a tonic and stimulant in low fevers. Stem bark is used as an ascarifuge and for gastric troubles. The bark of the stem is a little warm and somewhat acrid, and is recommended by Indian physicians to use as a decoction in low fever.

Seed oil is applied on the skin in rheumatism. The oil is digestive. Cure “vata” (Ayurveda). The seeds have a bitter sharp taste; purgative, tonic to the liver; improve diuresis (Ynani).

The tooth-brushes made of the wood strengthen the gums, keep them from becoming spongy, and improve digestion.

2.2. Phytochemical profile

2.2.1. Khalil et al. (2006) investigated the stems of *Salvadora persica* resulted in the first isolation of four benzylamides from a natural source. The isolated compounds were identified as butanediamide, \(N_1 N_4\)-bis (phenylmethyl) -2(S) – hydroxyl -butanediamide(I), \(N\)-benzyl-2-acetamide(I), \(N\)-benzylbenzamide(III), and benzylurea(IV).\(^{25}\)

2.2.2. Howaida F et al. (2003) identified that the twigs and roots of *Salvadora persica* contains oleic, linolic, and stearic acids. Among the compounds identified are esters of fatty acids and of aromatic acids, and some terpenoids.\(^{26}\)

2.2.3. Alali F et al. (2005) revealed that the major components from the essential oil of the toothbrush tree *S. persica* stem have been identified as 1,8-cineole(eucalyptol)(46%), a-caryophellene (13.4%), b-pinene (6.3%), and 9-epi-(E)-caryophellene.\(^{27}\)

2.2.4. Alali F et al. (2003) revealed that GC-MS analysis of the volatile oil extracted from *S. persica* leaves contains benzyl nitrile, eugenol, thymol, isothymol, eucalyptol, isoterpinolene, and b-caryophyllene as important constituents.\(^{28}\)
2.2.5. Hattab F N et al. (1997) analyzed the sticks from *S.persica* for their soluble and total content of fluoride, calcium, phosphorus, and silica. There was a substantial amount of silica in the ashes of miswak.29

2.2.6. Darout I A et al. (2000) investigated the aqueous extract of stem and root of *S. persica* L. for some antimicrobial anionic components by using capillary electrophoresis techniques. It was reported that the root and stem extracts contain sulfate, chloride, thiocynate, and nitrate.30

2.2.7. Kamal M S et al. (1992) reported three lignan glycosides from the stem of *S. persica*31

2.2.8. Abdel-Waheb S M et al. (1990) detected flavonoids rutin and quercetin in the stem of *S.persica*.32

2.2.9. Ray A B et al. (1975) reported Salvadourea in the root of *S.persica*.33

2.2.10. Al-Bagieh N H et al. (1990) isolated Benzylisothiocynate from the root of *S.persica*.34

2.2.11. Malik S et al. (1987) reported Salvadoricin; a new indole alkaloid in the leaves of *S. persica*. Its structure was elucidated by spectral analysis and confirmed by synthesis.35

2.3. Pharmacological profile

2.3.1. Antimicrobial activities

2.3.1.1. Firas et al. (2008) investigated aqueous and methanol extracts of *S. persica* for its antimicrobial activities against seven isolated oral pathogens - *Staphylococcus aureus*, *Streptococcus mutans*, *S. faecalis*, *S. pyogenis*, *Lactobacillus acidophilus*, *Pseudomonas aeruginosa*, and *Candida albicans* - using disc diffusion and microwell dilution assays. According to both antimicrobial assays, the aqueous extract inhibited all isolated microorganisms, especially the *Streptococcus spp.*, and was more efficient than the methanol extract, which was resisted by *L. acidophilus* and *P. aeruginosa*. The strongest antibacterial activity was observed using the aqueous extract against *S.
faecalis (zone of inhibition: 22.3 mm; MIC: 0.781 mg/ml). Both extracts had equal antifungal activity against C. albicans based on the turbidity test (MIC: 6.25 mg/ml).\textsuperscript{36}

2.3.1.2. Sofrata A H et al. (2008) studied \textit{in vitro} antibacterial effect of miswak pieces without extraction. The antibacterial effect was found most pronounced on \textit{P. gingivalis}, \textit{A. actinomycetemcomitans}, and \textit{H. influenzae}, less on \textit{Strep. mutans}, and least on \textit{L. acidophilus}. Miswak embedded in agar, or suspended above the agar plate, had strong antibacterial effects against all bacteria tested. The antibacterial effect of suspended miswak pieces suggested the presence of volatile active antibacterial compounds.\textsuperscript{37}

2.3.1.3. Poureslami H R et al. (2007) found that, Miswak (\textit{S. persica}) extract inhibits the growth of some dental plaque bacteria, and antibacterial effect of the herbal toothpaste was significantly greater than that of the placebo.\textsuperscript{38}

2.3.1.4. Darmani H et al. (2006) reported that aqueous extracts of miswak and derum enhance the growth of fibroblasts and inhibit the growth of cariogenic bacteria, with the derum extract showing greater activity than miswak.\textsuperscript{39}

2.3.1.5. Almas and Ahmad (2005) compared the antimicrobial activity of eight commercially available mouthrinses and 50% miswak extract against seven microorganisms. Corsodyl, Alprox, Oral-B advantage, Florosept, Sensodyne, Aquafresh mint, Betadine, and Emoform mouthrinses were used, while 50% aqueous extract of miswak (\textit{S. persica}) was used against \textit{Strep. faecalis}, \textit{Strep. pyogenis}, \textit{Strep. mutans}, \textit{C. albicans}, \textit{Staph. aureus}, and \textit{Staph. epidermidis}. Mouthrinses containing chlorhexidine (CHX) had maximum antibacterial activity, while cetylpyridinium chloride mouthrinses had moderate, and miswak extract had low antibacterial activity.\textsuperscript{40}

2.3.1.6. Al-Ali and Al-Lafi (2003) reported that volatile oil extracted from \textit{Salvadora persica} L. leaves, showed antibacterial effect on several different oral aerobic bacteria\textsuperscript{41}. 
2.3.1.7. Almas K (2001) reported that the aqueous extract of *S. persica* found in Pakistan and other Asian countries showed antimicrobial activity\(^42\).

2.3.1.8. Almas K (1999) compared the antimicrobial activity of Neem and Arak chewing stick's aqueous extracts at various concentrations. Data suggested that both chewing stick extracts were effective at 50% concentration on *Strep. mutans* and *Strep. faecalis*. Arak extract was more effective at lower concentrations for *Strep. faecalis*\(^43\).

2.3.1.9. Hammad et al. (2005) investigated the effect of preincubation of either *Streptococcus mutans* or buccal epithelial cells (BECs) with different concentrations of aqueous *Salvadora* twigs extract (ASTE) as well as the effect of mouth rinse with ASTE and chlorhexidine digluconate on the adhesion of bacterial cells to BEC. There was a significant reduction in the adherence of bacterial cells to BECs (84%) after mouth rinse with 20% ASTE compared to 45% adhesion inhibition with chlorhexidine digluconate\(^44\).

2.3.1.10. Khalid almas (1999) evaluated the antimicrobial effects of extracts of bark, pulp and entire *S. persica* in standardized experimental conditions 1,5,10 and 50% concentrations which were tested against five different microorganisms namely *Staphylococcus faecalis*, *Staphylococcus aureus*, *Staphylococcus epidermis*, *Candida albicans* and *Streptococcus mutans* using the blood agar ditch-plate method. The bark was effective against *S. feacalis* and *S. mutans* at 5,10 and 50% concentration and the whole miswak is more effective compared with bark or pulp separately\(^45\).

2.3.2. Anthelmintic activity

Datsu Kalip Reuben et al. (2011) determined the phytochemical constituents of aqueous extracts of shoots and leaves of *Salvadora persica* L. and root bark of *Terminalia avicenoides* and compared their anthelmintic efficacies against those of commercially available anthelmintics (albendazole and levamisole). The preliminary phytochemical screening of the extracts revealed the presence of tannins, flavonoids, saponins, sterols and terpenes and reducing sugars in all the extracts. The anthelmintic study showed that all the extracts exhibit in vitro anthelmintic activities against strongyline nematodes in a concentration dependent fashion and such effects were significant (p<0.001) when compared to those of albendazole and levamisole at the concentrations used in the experiment\(^46\).
2.3.3. Release of calcium and chloride into saliva
Gazi et al. (1992) investigated the immediate and medium-term effect of miswak on the composition of mixed saliva. They reported that meswak releases substances into saliva that could improve oral health, calcium and chloride values were similar to those of controls after 4 h and thus frequent use of meswak may be necessary to maintain a favorable salivary environment.47

2.3.4. Cytotoxic activity
2.3.4.1. Mohammad et al. (2006) investigated the cytotoxic potential of *Salvadora persica* on gingival and other periodontal structures, using the agar overlay method. Results showed no cytotoxic effect by a freshly cut and freshly used miswak. However, the same plant used after 24 h does contain harmful components. The cytotoxicity in this study became evident only after 24 h because the agar overlay method depends on the diffusion of the medicament to the agar material.48

2.3.4.2. Rajabalian et al. (2009) evaluated the cytotoxic activity of *S.persica* and CHX. The results indicated that both *S.persica* and CHX mouthwashes were toxic to macrophage, epithelial, fibroblast, and osteoblast cells in a concentration-dependent manner.49

2.3.5. Tick-repellent properties
Garboui et al. (2009) evaluated tick-repellent effects of the essential oils of *S.persica*, *Pistacia*, and *Juniperus phoenicea* using host-seeking nymphs of *Ixodes ricinus* in the laboratory. Significant tick-repellent effects were observed for the oils of all three species, but the duration of action was short50.

2.3.6. Antidental caries potential
2.3.6.1. Aldini E Z et al. (2007) investigated and compared the efficacy of natural toothbrush or miswak in the prevention of dental caries with the efficacy of ordinary toothbrush and toothpaste. The data collected at the end of the study showed that the risk of dental caries for each tooth in the control group was 9.35 times more than the case group.51
2.3.6.2. Sofrata A (2007) reported that rinsing with miswak extract (*S.persica*) stimulated parotid gland secretion and raised the plaque pH, suggesting a potential role in caries prevention.52

2.3.6.3. Araman A (1985) studied the abrasiveness of *Salvadora persica* in toothpastes or when used as a toothpaste. The tests indicated that a lower degree of abrasiveness than regular toothpastes or natural bristle toothbrushes.53

2.3.6.4. Nawan A et al. (2007) evaluated the *in-vitro* and *in-vivo* antimicrobial effects of an alcoholic extract of *Salvadora persica* solution as a root canal irrigant and compared it with the currently used root canal irrigants (5.25% sodium hypochlorite, 0.2% chlorhexidine and normal saline). Results revealed that 15% alcoholic extract of *Salvadora persica* had significant antimicrobial effect which was not significantly different from sodium hypochlorite and chlorhexidine and significantly different from normal saline54.

2.3.6.5. Abo A L Samh et al. (1997) evaluated, *in vitro*, the effect of different concentrations of miswak extract on L929 cell line in tissue culture and compared the results with sodium hypochlorite (NaOCl). They found a concentration-dependent morphologic change of L929 cell line when exposed to miswak extract and NaOCl. They suspect recovery of the cells after a 4-h exposure period to different miswak extract concentrations.55

2.3.7. Anti-inflammatory and analgesic potential

2.3.7.1. Mansour et al. (1996) evaluated the extract of root and branches of *S.persica* for analgesic activity in mice. It was found that the drug possesses a relatively moderate analgesic effect which might be due to interaction with the central and/or peripheral opiate system.56

2.3.7.2. Ezmiril S T et al. (1979) reported that the extract of stem of *S. persica* possess anti-inflammatory activity.57
2.3.8. ACE-inhibiting ability
Nyman V (1998) reported that in vitro screening S. persica possesses high ACE-inhibiting ability.58

2.3.9. Antiplasmodial activity
Ali et al. (2002) evaluated nineteen plant species, used traditionally in Sudan against malaria and similar tropical diseases. Different extracts of S. persica against P. falciparum NF54 strain were found to possess antiplasmodial activity.59

2.3.10. Antiplaque activity
2.3.10.1. Mohammed B et al. (2006) observed that miswak was as effective as a toothbrush for reducing plaque on buccal teeth surfaces both experimentally and clinically.60

2.3.10.2. Salman T H A et al. (2005) reported that the water extract (10%) of S. persica is an effective antimicrobial agent when utilized clinically as an irrigant in the endodontic treatment of teeth with necrotic pulps.61

2.3.10.3. Khalessi A M et al. (2004) compared the oral health efficacy of persica mouthwash (containing an extract of S. persica) with that of a placebo. The study showed that use of persica mouthwash improves gingival health and lower carriage rate of cariogenic bacteria when compared with the pretreatment values. Neither the persica nor the placebo reduced the accumulation of dental plaque.62

2.3.10.4. Otaibi A L et al. (2004) reported that, use of miswak revealed that it is at least as effective as toothbrushing for reducing plaque and gingivitis and that the antimicrobial effect of S. persica is beneficial for prevention or treatment of periodontal disease.63

2.3.10.5. Almas and Al-Zeid (2004) conducted clinical study using patients' saliva and measuring the effect of miswak (chewing stick), miswak extract, toothbrush, and normal saline on mutans and lactobacilli. The results showed that there was a marked reduction in Strep. mutans among all groups. When the groups were compared, the reduction in S. mutans was significantly greater using miswak in comparison to
toothbrushing and there was no significant difference for lactobacilli reduction. The investigators concluded that miswak has an immediate antimicrobial effect. *S. mutans* were more susceptible to miswak antimicrobial activity than lactobacilli.\(^{64}\)

### 2.3.10.6. Kaur S (2004) reported that Persica mouthwash significantly lowers the gingival index, plaque index, and bleeding index in case group without any side effects.\(^{65}\)

### 2.3.11. Effects on fertility

Darmani et al. (2003) investigated the effects of an extract of miswak for 30 days on the reproductive system of the mouse. The results showed that the exposure to miswak extract did not have much effect on female mouse fertility, although it caused a significant decrease in the relative weights of the ovary and an increase in uterine weights. Exposure of male mice to miswak extract resulted in a 72% reduction in pregnancies in untreated females impregnated by test males. The relative weights of the testes and preputial glands were significantly increased and that of the seminal vesicles was significantly decreased in test males.\(^{66}\)

### 2.3.12. Anticonvulsant and sedative potential

Monforte et al. (2002) studied the effect of *S. persica* stem extracts on the potentiation of sodium pentobarbital activity and on generalized tonic-clonic seizure produced by pentylenetetrazol (PTZ) on the rats. The extracts of *S. persica* extended sleeping time and decreased induction time induced by sodium pentobarbital. In addition, it showed protection against pentylenetetrazol-induced convulsion by increasing the latency period and diminishing the death rate.\(^{67}\)

### 2.3.13. Antiulcer activity

#### 2.3.13.1. Monforte M T et al. (2001) reported the antiulcer activity of decoction of *S. persica* against ASA-induced ulcer in rats. The ulcer index significantly decreased after the treatment with a lyophilized decoction of *S. persica* (500 mg/kg, os), once daily for 7 days, with respect to controls. Moreover, *S. persica* decoction possesses significant anti-inflammatory activity.\(^{68}\)
2.3.13.2. Sanogo R et al. (1999) confirmed the antiulcer activity of *S. persica* decoction using optical microscopy. The elements of gastric mucosa tended to be reestablished normally in treated rats.\(^69\)

2.3.14. Removal of smear layer and occlusion

2.3.14.1. Almas K (2001) reported that soaking the healthy and periodontally diseased root dentine in miswak extract resulted in partial removal of smear layer, and occlusion of dentinal tubules was observed in dentine specimens brushed with miswak solution\(^70\).

2.3.14.2. Ismail A D et al. (2000) reported that *S. persica* contains potential antimicrobial anionic components, and the capillary electrophoresis is a convenient method for their identification and quantification.\(^71\)

2.3.15. Antihyperlipidemic activity

2.3.15.1. Galati E M et al. (1997) investigated the effects of prolonged administration of a lyophilized stem decoction of *S. persica* in diet-induced rat hypercholesterolemia. The results showed that the *S. persica* decoction significantly lowered cholesterol and LDL plasma levels in rats.\(^72\)

2.3.15.2. Galati et al. (1999) reported that *S. persica* decoction was able to reduce cholesterol and LDL plasma levels. Mice injected with *S. persica* extract also showed a significantly lower number of stereotype movements of the mice. Stems of *S. persica* reduced cholesterol and LDL plasma levels. However, HDL and triglycerides were unchanged\(^73\).

2.3.16. Antimycotic potential

Al-Bagieh et al. (1994) showed that miswak extract at a concentration of 15% and above has a fungistatic effect for up to 48 hours. The antimycotic effect was probably due to one or more of the root contents which included chlorine, trimethylamine, and alkaloid resin, and sulfur compounds.\(^74\)
2.3.17. Locomotor activity
Sulaiman M I et al. (1986) reported the effects of *Salvadora persica* extracts on mice exploratory locomotion activities. The exploratory locomotion of *Salvadora persica* treated mice declined faster than that of the controls. Mice injected with *Salvadora persica* extract also showed a significantly lower number of stereotype movements (p less than 0.05). The stereotype movements of the control was 175 ± 5 movements/5 min and 90±10, 118±15 and 35±11 for mice injected with 5.7, 14.3 and 28.6 ml/kg *Salvadora persica* extract respectively.

2.3.18. Hypoglycemic activity
Trovato et al. (1998) observed significant hypoglycemic activity of *S. persica* in rats.

2.3.19. Diuretic activity
Bhadoriya U et al. (2010) investigated the diuretic effect of methanolic extract of the dried leaves of *Salvadora persica* in normal rats. Methanolic extract of *Salvadora persica* produced notable diuretic effect which appeared to be comparable to that produced by the reference diuretic HCTZ (Hydrochlorothiazide).

2.4. Clinical Studies
Poosti et al. (2006) compared the effects of Chlorhexidine (CHX) and *persica* mouth rinses on periodontal status of patients undergoing fixed orthodontic. Gingival index had a significant reduction in all groups after prescribing mouth rinses but this reduction was not significant between groups. Mean pocket depth in CHX group and gingival bleeding index in *persica* group had significant reduction. Plaque index did not show significant reduction in any of the groups.

2.5. Other herbs evaluated for antilithiatic activity
2.5.1. Christina A J et al. (2005) evaluated the antilithiatic effect of *Asparagus racemosus* Wild on ethylene glycol induced lithiasis in male albino Wistar rats. The results showed that the ethanolic extract inhibited stone formation induced by ethylene glycol treatment.
2.5.2. Christina A J et al. (2002) studied the modulatory effect of *Cyclea peltata* Lam on stone formation induced by ethylene glycol treatment in rats. The observations concluded that the plant inhibited the stone formation induced by ethylene glycol treatment.

2.5.3. Freitas A M et al. (2002) evaluated the effect of *Phyllanthus niruri* on urinary inhibitors of calcium oxalate crystallization and other factors associated with renal stone formation. The results showed that *Phyllanthus niruri* has an inhibitory effect on crystal growth, which is independent of changes in the urinary excretion of citrate and magnesium, but might be related to the higher incorporation of glycosaminoglycans (GAGs) into the calculi.

2.5.4. Zhongguo et al. (2003) reported that ethyl acetate extract of *Alisma orientalis* can significantly inhibit urinary calcium oxalate stone formation induced in rats by ethylene glycol and ammonium chloride.

2.5.5. Christina et al. (2002) studied the antilithiatic effect of *Rotula aquatica* lour in male Wistar rats. The decoction reduced calcium and oxalate ion concentration in urine, confirming the stone inhibitory effect.

2.5.6. Karadi R V et al. (2006) studied the effect of oral administration of aqueous and alcoholic extract of *Moringa oleifera* root-wood on calcium oxalate urolithiasis. The results indicated that the root-wood of *Moringa oleifera* is endowed with antiurolithiatic activity.

2.5.7. Patil Chandragouda et al. (2008) found that hydroalcoholic extract of *Klanchoe pinnata* exert significant diuretic and antirolithiatic activity on ethylene glycol induced urolithiasis. However, at higher doses the extract was found to perturb the biochemical parameters suggesting kidney toxicity.

2.5.8. Varatharajan Sudhahar (2008) studied the antirolithic effect of lupeol and lupeol linoleate in experimental hyperoxaluria. The results revealed that both compounds may serve as candidates for alleviating oxalate toxicity.
2.5.9. Vargas R et al. (2002) tested the aqueous extract of bark of Salix taxifolia for antilithiatic and diuretic activities. Urolithiasis was induced by implantation of zinc disc in urinary bladder of rats. A significant decrease in the weight of the stones was observed after treatment with the aqueous extract.  

2.5.10. Sounrarajan P et al. (2006) studied the effect of Aerva lanata on calcium oxalate urolithiasis in rats. The results confirmed that Aerva lanata can be used as an curative agent for urolithiasis.

2.5.11. Coothan Kandaswamy Veena et al. (2007) evaluated the beneficial role of sulfated polysaccharides from edible seaweed Fucus vesiculosus in experimental hyperoxaluria. The results showed that advocation of sulfated polysaccharides enhanced the antioxidant status, thereby preventing membrane injury and alleviating the microenvironment favourable for stone formation.

2.5.12. Mani Santhosh Kumar et al. (2003) reported that supplementation of vitamin E and selenium prevented hyperoxaluria in experimental urolithic rats.

2.5.13. R.B. Ghosh (2000) studied the antiurolithiatic activity of Coleus aromaticus Benth in rats. The results indicated that administration of aqueous extract of leaves of Coleus aromaticus reduced the deposition of calcium oxalate stone in kidney of rats with calculi producing diet (CPD).

2.5.14 Pankaj Gupta et al. (2006) evaluated antiurolithiatic effect of petroleum ether extract of stem bark of Crataeva adansonii in rats. Calcium oxalate nephrolithiasis was induced by intraperitoneal injection of sodium oxalate (7 mg/100 g) daily for 7 days. The results indicated that the prophylactic and therapeutic treatment with petroleum ether extract of bark of Crataeva adansonii had an inhibitory effect on crystal growth, with improvement of kidney function as well as cytoprotective effect.

2.6. Literature review on isolated compound β–amyrin
2.6.2. Otuki M F et al. (2005) evaluated the antinociceptive properties of mixture of alpha – amyrin & beta – amyrin triterpenes.94

2.6.3. Subarnas A et al. (1993) studied pharmacological properties of beta amyrin palmitate, a novel centrally acting compound, isolated from *Lobelia inflata* leaves95.

2.6.4. Gislei F (2009) evaluated the neuropharmacological profile of acetylated alpha- and beta-amyrin (AcAMY) obtained by the acetylation of the isomeric mixture of alpha- and beta-amyrin isolated from *Protium heptaphyllum*. The results showed that AcAMY presents sedative, anxiolytic and anticonvulsant properties. Although the drug mechanism of action is not completely clarified, it seems to involve a decrease in excitatory amino acids and an increase of inhibitory amino acids. Furthermore, the GABA (Gamma amino butric acid) system may also play a role96.