

**A SERIES ON THE MEDICINAL EFFECTS OF WILD  
PLANTS OF SAUDI ARABIA**

**2b- EFFECT OF WATER EXTRACT OF MUTANT *Cassia  
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FOREGUT AND HINDGUT MUSCLES**

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**Key Words:** Locust (*Locusta migratoria*), Foregut, Hindgut, Muscle  
Contraction, Water Extract (Aqueous Water), Mutant *Cassia senna*,  
Spontaneous Activity (Spt.act), Serotonin (5-HT).

**ABSTRACT:** The present study showed that the foregut and hindgut  
spontaneous activities of locust (*Locusta migratoria*) was inhibited upon the  
addition of a mutant of *C. senna* aqueous extract. It also induced muscle  
contractions at lower doses. This inhibitory action was dose-dependent and  
was stronger on hindgut muscles. The inhibitory effect brought about due to  
irradiation of the seeds may have altered the cation and anthrone glycosides /  
sennoside contents in the leaves and consequently altered the electrolyte  
transport *via* cell membrane stimulating involuntary muscle responses. In  
addition, gamma irradiation may reduce competitive effect of  $Mg^{2+}$  with  $Ca^{2+}$ -  
ions, and cause muscle contraction failure even in the presence of the  
excitatory agent 5-HT. This action may interfere with 5-HT-action on both  
muscle segments indicating that senna extract at high doses could have an

antagonistic activity with 5-HT. In general, irradiating seeds of *C. senna* with low gamma ray doses might have produced gene mutant and improved the quantity and quality of the bioactive components of this medicinal plant.

## INTRODUCTION

Migahid (1978) reported that *Cassia senna* (*C. senna*) is a leguminous wild plant growing in mountains and valleys of Southern Hijaz region of Saudi Arabia. Meelad (1983 & 1987) found this plant growing between the rocks and sandy soil in mountains and valleys of Makkah. The senna plants are also found in different parts of Africa and Asia cultivated in similar habitats (Hussain, 1979; Franz, 1993). Recent studies indicate that leaf extracts of this plant contain anthraquinone / glycosides (Sennoside A, B, C and D), which is a laxative agent, as well as some tannins, sterols, mucilages (Al-Masry, 1975; Hussain, 1979) and various ions such as Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup> and Mg<sup>2+</sup> (Patel, *et al.*, 1980; Meelad, 1983).

Mutants of economic importance were first reviewed by Gregory (1957) especially the gene mutants which were produced in order to improve the quantity and quality of plants. Most of the studies on *C. senna* extract, so far, have been conducted on humans and other mammals (Vogel, 1975; Ablordeppey & Ayim, 1983). Kolhekon, *et al.* (1975) irradiated *C. holosericea* seeds with doses of 15, 20 and 25 Kilorad gamma rays (kr). He isolated a

mutant which gave a higher yield of leaves and flowered longer than the non-irradiated. Van-Doorne, *et al.* (1988) studied the effect of low and high doses of gamma irradiation on senna leaves. They found that there was no change in sennoside content and composition after irradiation with 25 kr. They reported that low doses of 10 kr were necessary to obtain a product of good microbiological quality. Moreover, they suggested that hot extraction is the method of choice for tea preparation.

Al-Dakan, *et al.* (1995) reported that Senokot extract completely inhibited the mutagenic effect of low concentrations of aflatoxin B<sub>1</sub> in the presence of metabolic activation of procarcinogens and may also interact with direct mutagens to produce some antimutagenic effects. However, an ethanol extract of crude senna leaves was found to be weakly mutagenic but its mutagenic inhibitory effect was less than Senokot extracts.

Mutwally and Meelad (1997) studied the effect of *C. senna* (mountain and valley samples) aqueous extract on the spontaneous activity (Spt.act) of locust foregut and hindgut muscles. The aqueous extract of this plant is used as a laxative in Saudi Arabian traditional medicine, where the dried leaves are boiled in water. After cooling, the extract was applied directly, without any addition, to the suspended tissues in the organ bath to determine its effect on muscle contractions. They found that senna extract inhibited Spt.act of both

locust compartments in a dose-dependent manner. This inhibitory action was stronger on hindgut muscles. They suggested that the inhibitory effect may be due to the presence of cations and anthrone glycosides / sennoside components or both of them, in *C. senna* thus altering electrolyte transport *via* cell membrane and stimulating involuntary muscle responses.

Mutwally (1994) and Mutwally (1997, under publication) reported that  $Mg^{2+}$ -ions compete with  $Ca^{2+}$ -ions on cell membrane causing muscle contraction failure even in the presence of the excitatory agent 5-HT. This action may interfere with 5-HT-action on both muscle cell membranes through  $Na^+ / K^+$ -transporting ATPase.

Meelad (1983) produced a mutant of *C. senna* by irradiating the seeds with low doses of 10 Kilorad gamma rays from 220 / Cobalt 60 source, thus producing an improved quality of *C. senna*. In the present study leave aqueous extracts of *C. senna* grown from irradiated seeds were used on Spt.act of locust (*Locusta migratoria*) foregut and hindgut visceral muscles to test the bioactivity of this medicinal plant on insects.

## **MATERIALS AND METHODS**

**Irradiating the seeds:** To improve the quality of the bioactive compounds of senna, the seeds of *C. senna* were exposed to low doses 10 Kilorad gamma rays (kr) from 220 / Cobalt 60 source at dose rate  $1.23 \times 10^5$  kr/ h (Meelad,

1983).

**Collection of plant leaves:** Mutant *C. senna* leaves (from top, middle and bottom) of twenty different shrubs growing in the valley samples of Makkah region, Saudi Arabia were collected. The leaves were dried in the electric oven at 70 °C for 24 hours before being ground to a fine powder in an electric food grinder (Moulinex).

**Aqueous extract of leaves powder:** Approximately 10 g of the powder were added to 200 ml of distilled water then heated at 60 °C for a period of one hour on a water bath then filtered.

**Muscle preparations:** Adult locusts of both sexes, reared in laboratory culture were used in this study. The colony was maintained at 27 °C and fed daily on green barley or grass with water supplied *ad libitum*. Dissections were made according to the method previously described by Mutwally and Jamel Al-Layl (1992). Three different concentrations of senna extract, 0.25, 0.5 and 1 ml (representing approximately 12.5, 25 and 50 mg of dried powder) were directly applied to the organ bath so as to test low and high effect of the extract on muscle contractions.

## RESULTS

The different concentrations of mutant *C. senna* (0.25, 0.5 and 1 ml)

aqueous extract gradually decreased normal activities of locust foregut and hindgut visceral muscles. At low concentrations, it depressed the base line tensions of both segments and caused small muscle contractions at the higher concentrations. Moreover, the inhibitory effect of the extract was stronger on the hindgut muscles. Upon returning to normal saline, the foregut muscles resumed their activities faster than the hindgut muscles (Figure 1).

The cumulative additions of mutant *C. senna* aqueous extract elicited and lowered the base line tensions of foregut muscles and decreased their Spt.act gradually. The additions of the extract also inhibited the Spt.act of hindgut muscles. After washout with normal saline, the foregut muscle activities returned to normal state faster than those of the hindgut, but the inhibitory effect of the extract was stronger on the hindgut Spt.act (Figure 2).

In Figure 3, addition of serotonin (5-HT) ( $10^{-5}$ M) increased foregut Spt.act. After washing with normal saline, the foregut muscles resumed their normal activities in a faster and stronger manner than the control. Although, pre-treatment of foregut muscle with aqueous extract of mutant *C. senna* initially enhanced the effect of 5-HT but it inhibited foregut Spt.act. In addition, post-treatment of foregut muscles with aqueous extract mutant *C. senna* inhibited the effect of 5-HT. The foregut muscles retained their normal activities gradually after washing with normal saline.

As shown in figure 4, the hindgut Spt.act increased after the addition of ( $10^{-5}$ M) 5-HT. Upon returning to normal saline, the hindgut muscles resumed their normal activities. Pre-treatments of hindgut muscle with aqueous extract of mutant *C. senna* caused muscle contracture accompanied with small twitches and decreased the effect of 5-HT. The post-treatments of hindgut muscle with aqueous extract of mutant *C. senna* inhibited the enhancement of 5-HT additions gradually. There was a delay in returning hindgut muscles to their normal activities.

## **DISCUSSION**

Faruqi, *et al.* (1973) reported that after ultrasonic treatment of the seeds, there were a 6 - fold increase in germination of *C. holosericea* seeds, whereas, seeds treated with red light and gibberellic acid (1) [77-06-5] resulted in 3 - fold and 4 - fold increase in germination, respectively. In addition, Srivastava, *et al.* (1980) stated that the prolonged exposure of growing senna plants to cycle light and darkness affects the biosynthesis of anthracene derivatives in their leaves. They also found that in the absence of light (after 48 hours), the conversion of non-rhein to rhein is suppressed as indicated by high proportion of non-rhein glycosides to total glycosides.

Atzorn, *et al.* (1981) reported the presence of high levels of sennosides in dried leaves and fruits of *C. angustifolia* whereas seeds alone, stems and

roots contained very little sennosides. Upon dehydration, sennoside B level in leaves rises steadily, this rise being inversely correlated with water loss. Franz (1993) concluded that the active constituents of the pods are similar to those of the leaves but are present in larger quantities. Ewe, *et al.* (1993) suggested that retarded colonic transit and disturbed defecation are the most prominent pathophysiological mechanisms during constipation. Both may be influenced by bulking agents and by laxatives such as senna. They reported also that colonic transit was reduced by Sennatin and by Agiolax and all drugs used increased stool weight significantly.

After 3 - 11 hours dosing, rhein concentration reached its highest level in the plasma probably according to absorption of free rhein and rhein release from prodrug (*e.g.* sennosides) by bacterial metabolism, respectively (Krumbiegel & Schulz, 1993). In this study, extract additions affected both gut muscle responses within 2 - 5 minutes, and after washout with normal saline both muscles resumed their normal activities faster and stronger. This action could be due to senna component actions, to washout with normal saline and to Ca<sup>2+</sup>-refilling.

Beubler and Kollar (1985) reported that oral administration of senna pod extract reversed net absorption of water, Na<sup>+</sup> and Cl<sup>-</sup> to colon net secretion and increased K<sup>+</sup> secretion in rat colon. Also, senna pod extraction stimulated

the output of prostaglandin E<sub>2</sub> into the colonic lumen. They concluded that anthraquinones exert their laxative action at least partially *via* stimulation of colonic fluid and electrolyte secretion, and that this secretion is mediated by stimulation of endogenous prostaglandin E<sub>2</sub> formation. From the present study we suggest that *C. senna* aqueous extract may stimulate both gut muscle fluids and their electrolytes, which are mediated by stimulation of prostaglandin E<sub>2</sub>.

In locust, the excitation-contraction (EC) coupling is mediated by an inwardly directed Ca<sup>2+</sup>-pulse which subsequently releases Ca<sup>2+</sup> from intracellular stores. These events of both divisions of the gut are based upon influx of [Ca<sup>2+</sup>]<sub>0</sub> which will induce [Ca<sup>2+</sup>]<sub>i</sub> release. The electrical and mechanical responses require influx of Ca<sup>2+</sup>-ions, which are reduced whether the extracellular fluid is deficient in Ca<sup>2+</sup> -ion or containing Mg<sup>2+</sup> even in the presence of the excitatory agent 5-HT (Huddart, 1985; Irvine, 1986; Mutwally, 1990; 1993; 1994 & Mutwally, 1997, under publication; Mutwally & Meelad, Under publication).

Serotonin (5-HT) appears to have a uniform action on insect visceral muscles. This drug stimulates the foregut and the hindgut of various cockroaches and locusts (Brown, 1965; Cook & Holman, 1978; Cook, *et al.*, 1969; Oldfield & Huddart, 1982; Mutwally, 1990 & 1993) and on heart muscles having an excitatory effect (Hiripi & Rozsa, 1973; Collins & Miller,

1977). The increase in contractile frequency most probably reflects an indirect action of 5-HT on the intrinsic plexus accelerating the rate of Spt.act discharge. Moreover, the increases in contraction amplitude and in muscle general tonus probably reflect a direct action of this drug on extra-junction receptors (Oldfield & Huddart, 1982; Mutwally, 1990 & 1993).

Dale and Court (1981) reported that over 20 aminoacids were detected in 9 *Cassia* species seeds. Assane, *et al.* (1994) used *C. italica* leaves and pods extract on guinea pigs intestinal motility *in vitro*. They found that the plant extract stimulates the intestinal contractions in a dose-dependent manner and the contractile activity was comparable to the acetylcholine (ACh), and acting similarly as ACh and was inhibited by atropine. Mutwally and Meelad (1997) and in the present study, found that the extract of *C. senna* initially enhanced the effect of 5-HT then gradually decreased it. This suggests that senna extract may act on the same receptors and may have an antagonistic effect to 5-HT. Barth, *et al.* (1994) reported skeletal muscle weakness and mitochondria swelling in cows after 10 days feeding on a ration contaminated with 21.5 % *Senna occidentalis* beans. In this study, senna extract dropped the base line tension and inhibited Spt.act of both tissues.

Woodford and Morrison (1969a) reported that ultrasonic irradiation increased the extraction rate of rhein glycosides, free anthraquinones and total

water-soluble solids from whole senna pericarps irrespective of the temperature conditions employed. Moreover, increasing ultrasonic power from 35 to 100 w increased the yield of extractable constituents over 15 minutes periods, the ratio of rhein glycosides to total water-soluble solids being higher in extraction prepared using ultrasound than those obtained by simple maceration but the ratio decreased slightly with an increase in ultrasonic power. Woodford and Morrison (1969b) found that, when the cellulose membrane was irradiated with ultrasound, the diffusion rate of sennoside (A) through the membrane into water was increased irrespective of the temperature conditions. On the other hand, using ultrasonic energy in the form of a powerful step-horn converter, ultrasonic extraction was more rapid and produced more aglycone than the infusion methods. The amount of heat applied here has an important effect in the extraction of *C. acutifolia* (Patel & Skaven, 1969).

Kaito, *et al.*, (1975) observed in rabbits and mice, that after 2 – 4 hours oral administration, the cathartic activity was dose-dependent and produced marked diarrhea in rabbit. The ED<sub>50</sub> value for this activity was 78 mg / kg for mice, and 10 tablets / rabbit. In mice, the highly active compounds of 1,8-dihydroxyanthracene derivatives exerted a high activity during the initial 3 hours after dosage, while the less active compounds were less virtually

inactive during this period. It was found that the rhein anthrone appeared to act initially like the highly active primary sennosides, sennoside (A) and sennidin, and later as the less active rhein. (Fairbairn & Moss, 1970).

Abed and Benmerabet (1981) reported that the content of  $K^+$  and  $Na^+$  in medicinal plants varied according to the species and the organ analyzed. Ayoup (1975) concluded that plants tended to accumulate salts in tops, particularly when growing in saline soils. Highest concentrations of salts (mostly  $Ca^{+2}$  and  $Na^+$ ) accumulated in the leaves with a gradient from bottom to top leaves and under high salinity and soil moisture stress; plant growth was reduced with shedding of some lower leaves. The effect of  $\gamma$ -irradiation dose levels from 0.3 - 3.0 kr on various crude drugs caused no change in the glycoside content of *Digitalis* or of senna. The hemolytic index of senega was not changed but an extraction of the treated sample was more viscous than of an untreated (Diding, *et al.*, 1973). Kouichiro and Kouichiro (1971) suggested that certain mineral constituents were present in ashed tissues of *Cassia angustifolia* and *Camellia japonica* leaves.

In the present study, separate additions of mutant *C. senna* extract were more active than cumulative additions on both muscle activities. These actions were dose-dependent on both muscles, but their effects were stronger on hindgut muscles. This could be related to ionic compositions and to anthrone

glycosides / sennosides product of *C. senna* aqueous extract and also to locust both muscle sensitivities to this medicinal plant. Magnesium sulphate is a saline laxative and is poorly absorbed from the digestive tract and so retains water by osmosis; peristalsis is increased indirectly. There is a fairly rapid onset of action 2 - 3 hours and the effect of  $Mg^{2+}$ -ions may be counteracted by  $Ca^{2+}$ -ions (Foster, 1990). Mutwally (1994 & Mutwally, 1997; Under publication) concluded that both  $Mg^{2+}$ - and  $Ca^{2+}$ -ions compete with each other on cellular membrane.

Stimulatory laxatives act by altering water and electrolyte transport as well as stimulating intestinal motility, senna is metabolized by bacteria in the colon to the active aglycone (Foster, 1990). Chronic use of laxatives results in an atonic, sluggish bowel and therefore contra-indicated defecation is promoted by increased colonic or small intestinal propulsive motility and altered electrolyte transport. The purgative anthraquinone glycosides are activated by hydrolysis and the enhanced automaticity of the muscle fibers is increased by an increase in  $Ca^{2+}$ -concentration, and decrease by an increase in  $K^{+}$ -concentration (Bowman & Rand, 1984).

Many of the traditional purgatives of vegetable origin owe their activity to anthraquinones which are present in the free form or as glycosides. There is evidence to suggest that long-continued use of anthraquinone

purgative results in damage to the mesenteric plexus, such as senna may cause gripe; this pain is a reflection of the increased motility of the colon. Some purgatives reflex by stimulating sensory nerve endings. In addition they inhibit glucose absorption in the small intestine and this may cause a bulk effect. Diarrhea may lead to dehydration and severe electrolyte imbalance, particularly  $K^+$ -deficiency and a negative  $Na^+$ -balance due to loss of plasma albumin in faeces (Bowman & Rand, 1984; Foster, 1990).

Mutwally and Meelad (1997) suggested that both *C. senna* (mountain and valley samples) aqueous extracts inhibited the Spt.act of both muscle compartments gradually and the inhibitory actions were dose-dependent and stronger on the hindgut muscles. In addition, senna extracts from both samples at lower doses enhanced the action of 5-HT to higher degree. In the present study, the senna aqueous extracts of the leaves grown from the irradiated seeds showed similar results. However, the inhibitory effect of senna extracts was more pronounced on natural activities of both muscle compartments. The senna extracts from leaves grown from irradiated seeds diminished the 5-HT activity as compared to the extract from non-irradiated seeds. This may indicate that senna extracts may act on 5-HT receptors and may have 5-HT antagonistic activity.

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#### **REFERENCES**

**Abed**, L. and Benmerabet, K. (1981) Significance of the study on potassium and sodium following infusions from medicinal plants. *Chem. Abst.*, Vol. 95: 225540n.

**Ablordeppey**, S.Y.S. and Ayim, J.S.K. (1983) Some problems associated with the quantitative analysis of crude hydroxyanthraquinone drugs. *Chem. Abst.*, Vol. 100: 39671c.

**Al-Dakan**, A.A., Al-Tuffail, M. and Hannan, M.A. (1995) *Cassia senna* inhibits mutagenic activities of benzo[a]-pyrene, aflatoxin B<sub>1</sub>, shamma and methyl methanesulfonate. *Pharmacol. Toxicol.*, Vol. 77 (4): 288-292.

**Al-Masry**, H. (1975) *Al-Aqrabazin wa almostahdarat alsaydalaniah* (Pharmacology and pharmaceuticals preparations). First Ed., Dar Al-Qualm, Al-Kuwait.

- Assane, M.;** Nydyema, R.; Bassene, E.; Sere, A. and Gaye, O. (1994) Purgative activity of *Cassia italica*. *Dakar Med.*, Vol. 39 (2): 125-128.
- Atzorn, R.;** Weiler, E.W. and Zenk, M.H. (1981) Use of immunoassay in plant sciences. Part 15. Formation and distribution of sennosides in *Cassia angustifolia* as determined by a sensitive and specific radioimmunoassay. *Chem. Abst.*, Vol. 94: 153432h.
- Ayoup, A.T.** (1975) Sodium and cation accumulation by senna (*Cassia acutifolia*). *Chem. Abst.*, Vol. 84: 102405n.
- Barth, A.T.;** Kommers, G.D.; Salles, M.S.; Wouters, F. and Barros, C.S. (1994) Coffee senna (*Senna occidentalis*) poisoning in cattle in Brazil. *Vet. Hum. Toxicol.*, Vol. 36 (6): 541-545.
- Beubler, E.** and Kollar, G. (1985) Stimulation of PGE<sub>2</sub> synthesis and water and electrolyte secretion by senna and anthraquinones are inhibited by indomethacin. *J. Pharm. Pharmacol.*, Vol. 37 (4): 248-251.
- Bowman, W.C.** and Rand, M.J. (1984) Textbook of pharmacology. Second edition, Blackwell scientific publication. London.
- Brown, B.E.** (1965) Pharmacologically active constituents of the cockroach corpus cardiacum: Resolution and some characteristics. *Gen. Comp. Endocrinol.*, Vol. 5: 387-401.
- Collins, C.** and Miller, T. (1977) Studies on the action of biogenic amines on

cockroach heart. *J. Exp. Biol.*, Vol. 67: 1-15.

**Cook**, B.J., Eraker, J. and Anderson, G.R. (1969) The effect of various biogenic amines on the activity of the foregut of the cockroach *Blaberus giganteus*. *J. Insect Physiol.*, Vol. 15: 445-455.

**Cook**, B.J. and Holman, G.M. (1978) Comparative pharmacological properties of muscle function in the foregut and hindgut of the cockroach *Leucophaea maderae*. *Comp. Biochem. Physiol.*, Vol. 61C: 291-295.

**Dale**, T. and Court, W.E. (1981) aminoacids of *Cassia* seeds. *Chem. Abst.*, Vol. 95: 21281u.

**Diding**, N.A.; Redmalm, G.R.; Samuelsson, G.S.; Frigren, L.; Yman, B.M. and Van Katwijk, I. (1973) Effect of  $\gamma$ -irradiation of crude drugs. *Chem. Abst.*, Vol. 80: 19476h.

**Ewe**, K.; Ueberschaer, B. and Press, A.G. (1993) Influence of senna fiber, and fiber + senna on colonic transit in loperamide-induced constipation. *Pharmacology*, Vol. 47 (Suppl. 1): 242-248.

**Fairbairn**, J.W. and Moss, M.J.R. (1970) Relative purgative activities of 1,8-dihydroxyanthracone derivatives. *Chem. Abst.*, Vol. 73: 97226w.

**Faruqi**, M.A.; Khan, M.A. and Uddin, M.G. (1973) Comparative study of the effect of ultrasonic, red light and gibberellic acid, on the germination of *C. holosericea* seeds. *Chem. Abst.*, Vol. 81: 509v.

- Foster**, R.W. (1990) Basic pharmacology. Second Ed. Butterworths. London.
- Franz**, G. (1993) The senna drug and its chemistry. *Pharmacology*, Vol. 47 (Suppl. 1): 2-6.
- Gregory**, W.C. (1957) Progress in establishing the effectiveness of radiation in breeding peanuts. In Proceeding Ninth. Oak Ridge. Regional Symposium, Plant Breeding, pp.36-48.
- Hiripi**, L. and Rozsa, K.S. (1973) Fluorimetric determination of 5-hydroxytryptamine and catecholamines in the cenervous system and heart of *Locusta migratoria migratorioides*. *J. Insect Physiol.*, Vol. 19: 1481-1485.
- Huddart**, H. (1985) Visceral muscle. Chapter 5. In "Comprehensive insect physiology, biochemistry and pharmacology. Vol. 11. Kerkut, G.A. and Gilbert, L.L. (Ed.). Pergamon Press. Oxford.
- Hussain**, F. (1979) Al-Nabatat Al-tipeia wa ziraatiha wa Mokawinatih (Medicinal plants, their cultivation and constituents), (Arabic). Al-Door Al-Arabia for books, Tunisia.
- Irvine**, R.F. (1986) Calcium transients : Mobilization of intracellular  $Ca^{+2}$ . *Br. Med. Bull.*, Vol. 42 no. 4: 369-374.
- Kaito**, T.; Masakatsu, N.M. and Hajime, F. (1975) Cathartic activity of a sennoside preparation. *Chem. Abst.*, Vol. 84: 38696d.
- Kolhekon**, S.; Deshmukh, V.K. and Saoji, A.N. (1975) Stimulating effect of  $\gamma$ -

radiation on growth of senna. *News* 1: 2,37.

**Kouichiro**, U. and Kouichiro, H. (1971) Applications of low-temperature ashing with high frequency oxygen plasma in pharmacognostical studies. Calcium oxalate crystals in ashed tissues of leaves of *Cassia angustifolia* and *Camellia japonica*. *Chem. Abst.*, Vol. 75: 126549c.

**Krumbiegel**, G. and Schulz, H.U. (1993) Rhein and aloe-emodin kinetics from senna laxatives in man. *Pharmacology*, Vol. 47 (Suppl. 1): 120-124.

**Meelad**, M.H. (1983) Some biological effects of gamma irradiation on *Cassia senna*. Ms. Thesis. Department of Biological Sciences. Faculty of Science, King Abdul Aziz University, Jeddah, Saudi Arabia.

**Meelad**, M.H. (1987) Some floristic and chemotaxonomic studies of the flowering plants of Makkah. Ph.D. Thesis. Department of Biological Sciences. University of Salford, Salford, U.K.

**Migahid**, A.M. (1978) Flora of Saudi Arabia. Second Ed., Vol. 1, Riyadh University, Riyadh, Saudi Arabia.

**Mutwally**, H.M.A. (1990) The structure, innervation and function of locust foregut visceral muscles. (Ph.D. Thesis). Biological Department, Lancaster University, U.K.

**Mutwally**, H.M.A. (1993) The effect of some biogenic amines on the spontaneous activity of locust (*Locusta migratoria*) foregut and hindgut

- visceral muscles. *J. Egypt Ger. Soc. Zool. Comp. Physiol.*, Vol. 11 (A): 47-56.
- Mutwally**, H.M.A. (1994) The effect of  $Mg^{+2}$  on spontaneous activity of foregut and hindgut muscles of *Locusta migratoria*. *J. Facu. Edu Ain Shams Univ. Press*, Vol. 19: 1-12.
- Mutwally**, H.M.A. (1997) The effect of  $Mg^{+2}$  on  $K^{+}$ -contracture and field stimulation responses of foregut and hindgut muscles of *Locusta migratoria*. (Under publication: *Inst. Res. & Revival Islamic Heritage Appl. Sci. & Eng. Res. Center, Makkah, Saudi Arabia*).
- Mutwally**, H.M.A. and Jamel Al-Layl, K.S. (1992) The effect of cyanobacterial neurotoxin on the locust (*Locusta migratoria*) foregut and hindgut visceral muscles. *J. Egypt Ger. Soc. Zool. Comp. Physiol.*, Vol. 9 (A): 203-220.
- Mutwally**, H.M.A. and Meelad, M.M.H. (1997) A series in medicinal effect of wild plants of Saudi Arabia: 2a- Effect of *Cassia senna* on the spontaneous activity of locust foregut and hindgut muscles. (Under publication: *Proceedings of The International Symposium on Herbal Medicine, 1997, Jeddah, Saudi Arabia*).
- Oldfield**, A.C. and Huddart, H. (1982) Spontaneous activity of foregut and hindgut of locust (*Locusta migratoria*). 1- Normal activity and the effect of KCl depolarization and glutamate. *Comp. Biochem. Physiol.*, Vol. 37 (C): 298-

302.

**Patel, M.R.;** Agrawal, Y.K. and Raj, K.P.S. (1980) Varying content of metals in four leafy drugs. *Chem. Abst.*, Vol. 94: 109179g.

**Patel, I.C. and Skaven, D.M.** (1969) Ultrasonic extraction of *Cassia acutifolia*. *Chem. Abst.*, Vol. 72: 245365.

**Srivastava, V.K.;** Gupta, R. and Maheshwari, M.L. (1980) Photocontrol of anthracene compounds formation in senna (*Cassia acutifolia* Vahl) leaves. *Chem. Abst.*, Vol. 94: 27411n.

**Van-Doorne, H.;** Bosch, E.H.; Zwaving, J.H. and Elema, E.T. (1988) Gamma irradiation of sennae folium. Microbiological and phytochemical studies. *Pharmacol. Weekbl. Sci.*, Vol. 10 (5): 217-220.

**Vogel, G.** (1975) Predictability of the activity of the drug combinations, Yes or No. *Chem. Abst.*, Vol. 83: 188401x.

**Woodford, R. and Morrison, C.J.** (1969a) Effect of ultrasonic energy on the extraction of anthraquinones from senna pericarps. *Chem. Abst.*, Vol. 71: 94715c.

**Woodford, R. and Morrison, C.J.** (1969b) Diffusion of sennoside A through a cellulose membrane. *Chem. Abst.*, Vol. 71: 94710x.

## **FIGURE LEGENDS**

**FIGURE 1: Separate additions of aqueous extract of mutant *C. senna* (250 ml, 500 ml and 1ml) on A) locust foregut muscles and B) hindgut muscles decreased their Spt.act gradually. After washout (W) with**

normal saline foregut muscles resumed their normal activities faster than hindgut muscles. Calibration, tension and time scales apply to all traces (n = 8).

**FIGURE 2:** Cumulative additions of mutant *C. senna* (250 ml, 500 ml and 1ml) aqueous extract dropped (A) foregut muscle base line tensions and inhibited Spt.act of both muscles gradually. The inhibitory effect was stronger on (B) hindgut muscles. After washout (W) with normal saline foregut muscles resumed their normal activities faster than hindgut muscles. Calibration, tension and time scales apply to all traces (n = 8).

**FIGURE 3:** Shows the effect of  $10^{-5}$ M 5-HT on foregut muscles (A-control). Although, pre-treatment (1 and 2) of mutant *C. senna* (250 ml and 500 ml) aqueous extract inhibited foregut Spt.act and initially increased the effect of 5-HT, yet it decreased it. In 3) similar actions were seen in post-treatments with mutant *C. senna* addition. After washout (W) with normal saline, foregut muscles resumed their normal activities faster. Calibration, tension and time scales apply to all traces (n = 8).

**FIGURE 4:** Shows the effect of  $10^{-5}$ M 5-HT on hindgut muscles (A-control). Pre-treatment (1 and 2) with mutant *C. senna* (250 ml and 500 ml) aqueous extract caused muscle contracture accompanied with small twitches but it decreased the effect of 5-HT. The post-treatment (3) of mutant *C. senna* addition inhibited the enhancements of 5-HT additions. After washout (W) with normal saline, hindgut muscles resumed their normal activities after short delay. Calibration, tension and time scales apply to all traces (n = 8).

دراسات على التأثيرات الطبية للنباتات العشبية في المملكة العربية السعودية

ب- أثر المستخلص المائي لنبات السنامكي المطفر على الانقباضات الطبيعية لعضلات

## معي الجراد الصحراوي الأمامية والخلفية

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المملكة العربية السعودية

الملخص:

أظهرت هذه الدراسة أن الانتقباضات العضلية الطبيعية لكلا معي الجراد الأمامية والخلفية قد ثبتت نتيجة لإضافة المستخلص المائي لأوراق السنمكي المنمأة من البذور المشبعة بجرعات قليلة من أشعة جاما، ألا أنها أحدثت انقباضة عضلية عند إضافة التراكيز الدنيا من المستخلص المائي. أثر هذا التثبيط كان تصاعدياً وكلما زاد تركيز المستخلص كان هذا الأثر أكثر وضوحاً على الأمعاء الخلفية للجرادة. هذا التثبيط يحتمل أن يكون سببه إشعاعات جاما والتي تكون قد أثرت على تأين العناصر وتركيزاتها وكذلك على محتويات الانثرون جليكوسيد / سينوسيد الموجودة في الأوراق وبالتالي فإنها أثرت على انتقال العناصر المتأينة خلال الغشاء الخلوي مستحثة العضلات للانتقباض.

إضافة على ذلك، فإن أشعة جاما يحتمل أنها قللت الآثار التنافسية بين أيونات الماغنسيوم والكالسيوم. ويستنتج من هذا البحث، احتمال أن يكون للمستخلص المائي أثر منافس لأثر مركب السيروتونين (5-HT).

وكننتيجة نهائية فإن تعريض بذور السنمكي لجرعات بسيطة من أشعة جاما يتوقع أنها قد أنتجت جينات مطفرة جيدة ويحتمل أن هذه بدورها قد حسنت المحتوى الكمي والكيفي للمادة الفعالة الحيوية لهذا النبات الطبي.