

Evaluation of the Anti-Motility Related Diarrhoeal Activity of the Sage Tea *Salvia officinalis* L. in Laboratory Mice

Jafar Abbas Issa AL-Maamori

Department of Biology, College of Science, University of Wasit, Wasit Province, AL-Kut, Iraq

Abstract: Sage tea *Salvia officinalis* L. extract was evaluated scientifically for its anti-motility-related diarrhoeal effect of mice in current study by using castor oil as laxative agent-induced diarrhoea model against loperamide as standard anti-motility-related diarrhoeal drug. Fifteen male mice were used and divided into three groups (5 animals group⁻¹) ⁺⁺⁺control, ^{-ve}control (loperamide treatment) and sage tea treatment groups, respectively. The results reported a reduction in purging index (137.78), significantly decreasing of the latency period (0.90±0.10) and number of stools (1.24±0.19) of *S. officinalis* L. sage tea treatment group as compared to ^{-ve}control (loperamide) (153.85), (2.00±0.32) and (1.30±0.20) and ⁺⁺⁺control groups (254.72), (5.40±0.81) and (2.12±0.10), respectively. Concludes from these findings that an inhibitory action of motility-related diarrhea effect of *Salvia officinalis* L. extract is evident from the experimental model like castor oil induced diarrhea may be attributed to therapeutic properties of this plant which contains pharmacologically active substances with anti-motility related diarrheal properties.

Key words: Motility-related diarrhoea, castor oil, sage tea *S. officinalis* L., loperamide, substance, Iraq

INTRODUCTION

Diarrhoea is defined by the World Health Organization as having ≥ 3 loose or liquid bowel movement per day or as having more stools than is normal for that person. It is a common cause of death in developing countries and the 2nd most common cause of infant deaths worldwide. The loss of fluids through diarrhoea can cause dehydration and electrolyte imbalances. In 2009, diarrhoea was estimated to have caused 1.1 million deaths in people aged ≥ 5 years and 1.5 million deaths in children under the age of 5 years. As well as according to the WHO (2004), diarrhoea is the cause of 3.3% of all deaths. In young children, it can lead to death due to dehydration and in survivor's impaired growth and malnutrition. In adults while the impact is less severe, it nevertheless can lead to nutritional deficiencies especially in the case of persistent diarrhoea. Diarrhoea, varied from the secretory, osmotic, motility-related, exudative, inflammatory, infectious and other diarrhoea.

Motility-related diarrhoea is caused by the rapid movement of food through the intestines (hypermotility). If the food moves too quickly through the gastrointestinal tract there is not enough time for sufficient nutrients and water to be absorbed. Diarrhoea can be treated with anti-motility agent like loperamide (Generic name: Loperamide hydrochloride) is effective at reducing the duration of diarrhoea (De Bruyn, 2008). With anti-motility diarrhoea properties of this synthetic chemical, its but not

free from side effects. So, the investigation of some herbal plants with antidiarrhoeal activity prerequisite like herbal sage tea *Salvia officinalis* L. to evaluation this potential activity of its anti-motility related diarrhoea. *Salvia officinalis* L. called sage is a popular plant belongs to the family of Labiatae and native to the Mediterranean region. Sage used as herbal tea and for food flavoring (Chalchat *et al.*, 1998). Also, it is a valuable medicinal plant which is used widely in traditional medicine. This plant species enjoys the reputation of being a panacea because of its wide range of medicinal effects. It has been used as an antibacterial (Lu and Foo, 2002), antifungal (Barberan, 1986), antiviral (Abad *et al.*, 1997) and anti-inflammatory (Recio *et al.*, 1995) and antihidrotic, spasmolytic, antiseptic and in the treatment of mental and nervous conditions (Baricevic and Bartol, 2000) activities. However, there are no scientific studies available on the anti-motility related diarrhoea effect of *Salvia officinalis* L. although, this plant is used as a folk remedy as a digestive medicine to treat upset stomachs, flatulence and diarrhea. Therefore, anti-motility related diarrhoea effect of sage was investigated in this study in laboratory mice.

MATERIALS AND METHODS

Laboratory animals: Fifteen male Balb/c mice, 3 months old, weighting 20-30 g were used for this study. The animals were purchased from Animal House/Centre

of Drug Control/Ministry of Health, Baghdad, Iraq and acclimated to the Laboratory Animal Facilities in animal house/Faculty of Science/Wasit University for at least 1 week before the start of the experiments. During this period, the animals were housed in standard cages, maintained on a natural light/dark cycle at $20\pm 2^{\circ}\text{C}$ and given rodent food and tap water *ad libitum*.

Plant material and preparation of sage tea: Sage *Salvia officinalis* L. plants were purchased from the local market of Al-Kut city, Wasit province, Iraq. A specimen has been classified as lush vegetation of the Iraqi National Council/the Ministry of Agriculture, Iraq.

The aerial parts of plants were lyophilized and kept at -20°C . The sage tea was routinely prepared by pouring 150 mL of boiling water onto 2 g of the dried plant material and allowing steeping for 5 min (Lima *et al.*, 2005).

Experimental design

Castor oil induced diarrhea: The procedure performed as per Kasture (Kasture, 2006). The animals were fasted for 18 h and divided into 3 groups of 5 animals/group⁻¹. The animal groups were induced for motility-related diarrhoea by castor oil (Inter Pharma laboratories), Syria before receiving any treatment vehicles. The 1st group (positive control group) received castor oil (1 mL mouse⁻¹) + distilled water (0.2 mL mouse⁻¹) orally, the 2nd group (negative control group) orally received castor oil (1 mL mouse⁻¹) followed by Loperamide hydrochloride, manufacturer: DIALUM©, Mission Vivacare Ltd., India (equivalent 0.171 mg kg⁻¹ body weight) after 1 h and the 3rd group (treatment group) orally received castor oil (1 mL mouse⁻¹) followed by (dose volume 4.28 mL kg⁻¹ body weight equivalent aqueous extract preparation of sage 60 mg kg⁻¹ body weight) after 1 h.

The Purging Index (PI): Animals from each group were placed in separate standard cages lined with blotting paper. The blotting paper was changed hourly and examined after every 30 min for presence of diarrhoea for up to 6 h. The latency to defecate stools in each mouse showing diarrhoea in each group was recorded, the Purging Index (PI) was calculated by the following equation (Kasture, 2006):

$$\text{PI} = \frac{\text{Responder} \times \text{average number of stools (\%)}}{\text{Average latent period}}$$

Statistics: Data were entered into vassar stats website for statistical computation. Data were expressed as

mean \pm SEM. Student t-test was used for the evaluation of values and $p < 0.05$ was considered to be statistically significant.

RESULTS AND DISCUSSION

As can be shown from Table 1, the current findings of observation for 6 h after orally castor oil administration, all the mice in the groups (⁺⁺⁺control, ⁺⁺treatment and sage tea treatment) produced severe diarrhoea with 100% responder. In this context, the castor oil induced diarrhoea model was adopted as the autacoids and prostaglandins are involved in causation of diarrhoea. The liberation of ricinolic acid from castor oil results in irritation and inflammation of intestinal mucosa, leading to production of prostaglandins which stimulate intestinal motility and secretion (Gatne *et al.*, 2008). The aqueous extract of *Salvia officinalis* L. caused a significant ($p < 0.05$) decreasing of stools number (1.24 ± 0.19) as compared to the positive control and negative treatment (loperamide) groups (5.40 ± 0.81 and 2.00 ± 0.32), respectively as well as the study showed a remarkable significant reduction on the latency period to defecate severity of the diarrhoea after orally administration of sage extract (0.90 ± 0.10) as compared to negative treatment (loperamide) group (1.30 ± 0.20).

Although, loperamide drug is a synthetic anti-diarrheal acts by slowing intestinal motility and by affecting water and movement through the bowel. Loperamide binds to the opiate receptor in the gut wall. Consequently, it inhibits the release of acetylcholine and prostaglandins thereby inhibitory influence on gastric and small bowel peristaltic activity manifests in increased Gastrointestinal Transit Time (GITT), one of the major determinants of drug absorption.

In addition, loperamide increases the tone of the anal sphincter thereby reducing incontinence and urgency. It has potent inhibitory action on gastrointestinal motility and gastric secretion (Heel *et al.*, 1978; Sundhu *et al.*, 1981).

Salvia officinalis L. extract has been shown a marked anti-motility related diarrhoeal effect as evidenced by the reducing in the purging index in sage treatment group (137.78) as compared to the other groups, positive control and negative treatment (loperamide) (254.72 and 153.85), respectively (Fig. 1) might due to the

Table 1: Effect of sage tea *S. officinalis* L. on castor-oil induced motility-related diarrhoea in mice

Groups	Responder for diarrhoea (%)	Latency period (h) ^a	No. of stools ^a
⁺⁺⁺ Control	100	2.12 ± 0.10	5.40 ± 0.81
⁺⁺ Treatment (loperamide)	100	$1.30 \pm 0.20^*$	$2.00 \pm 0.32^*$
Sage tea treatment	100	$0.90 \pm 0.10^*$	$1.24 \pm 0.19^*$

^aValues represent mean \pm SEM (n = 5), * $p < 0.05$ vs. ⁺⁺⁺control group

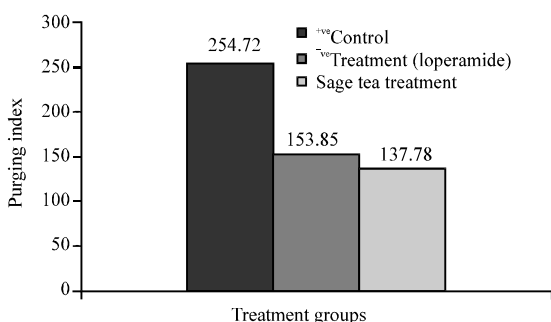


Fig. 1: The purging index of sage tea *S. officinalis* L. effect on castor oil induced motility-related diarrhoea in mice

special phytostructure of *S. officinalis* against motility-related diarrhoea. So, this an anti-diarrheal properties may be belong to sharing out some bioactive compounds are found in the sage tea *S. officinalis* L. that possess an inhibitory action of diarrhoea such as an essential volatile oil, flavonoids, phenolic acids, resin, saponins, thujone, silica and tannins. In this context, the volatile oils have a relaxant effect on the smooth muscle of the digestive tract while in conjugation with the bitters; they stimulate the appetite and improve digestion. Sage encourages the flow of digestive enzyme and bile, settles the stomach, relieves colic, wind, indigestion, nausea, diarrhea and colitis, liver complaint and worms. Its antiseptic properties are helpful in infection such as gastroenteritis. Furthermore, antidiarrheal properties of some medicinal plants were found to be due to tannins, flavonoids, alkaloids, saponins, reducing sugar, sterols and/or terpenes (Otshudi *et al.*, 2000; Venkatesan *et al.*, 2005). The anti-diarrheal activity of flavonoids has been ascribed to their ability to inhibit intestinal motility and hydro-electrolytic secretion which are altered in this intestinal condition. *In vitro* and *in vivo* experiments have shown that flavonoids are able to inhibit the intestinal secretory response induced by prostaglandins E2 (Di-Carlo *et al.*, 1993). Furthermore during experimental observations, the sage group returned noticeably to eat rodent food and drinking water routinely compared to the rest of the positive and negative groups were associated with the purging index.

CONCLUSION

The findings of this study revealed that extract of sage tea *S. officinalis* possess an inhibitory action on motility-related diarrhoea may attributed to therapeutic properties of this plant which contains pharmacologically active substances with anti-diarrheal properties and advised to use in traditional medicine safely. Further

research is requested to investigate the phyto-chemical analysis of bioactive compounds are responsible for the anti-motility-related diarrheal activity observed of this herbal plant.

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