

Analysis of antidiarrhoeic effect of plants used in popular medicine*

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People customarily use the extracts of plants known to have antidiarrhoeal effects without any scientific base to explain the action of the extract. For this reason, an investigation was undertaken with a view to determining the efficacy of the effects of the brute aqueous extract (BAE) of the leaves of *Psidium guajava* (guava), *Stachytarpheta cayenensis* (bastard vervain), *Polygonum punctatum* (water smartweed), *Eugenia uniflora* (Brazil or Surinam cherry) and *Aster squamatus* (zé-da-silva) on the intestinal transport of water in rats and on the gastrointestinal propulsion in mice. With the exception of the BAE of *S. cayenensis*, all other BAE's have increased the absorption of water in one or more intestinal portion in relation to the control group. All tested BAE, except that of *P. punctatum*, reduced the gastrointestinal propulsion in relation to that of the control group. The results indicate that the BAE of the leaves of *P. guajava*, *S. cayenensis*, *P. punctatum*, *E. uniflora* and *A. squamatus* have a potential antidiarrhoeic effect to be confirmed by additional investigations in animals infected with enteropathogenic agents.

Diarrhea, therapy. Plant extracts, pharmacology. Plants, medicinal.

Introduction

In the Third World, diarrhoeal diseases are responsible for the deaths of millions of people each year²² and it is, thus, a serious public health problem. Most persons who suffer from this problem are socially underprivileged individuals, and consequently, almost without access to allopathic medicine. For this reason, an investigation was made with a view to determining the efficacy of those plants commonly used in Southern Brazil for medical diarrhoeic care: *Psidium guajava* L. var. *pommiferum* (guava/goiabeira), *Stachytarpheta cayenensis* (L.C. Rich) Vahl. (bastard vervain/gervão), *Polygonum punctatum* Elliot. (water smartweed/polígono or pimenta d'água), *Eugenia uniflora* L. (Brazil or Surinam cherry/pitangueira) and *Aster squamatus* (Spreng.) Hieron (zé-da-silva). The leaves, roots and flowers of *P. guajava* are customarily used in tropi-

cal and subtropical regions^{4,5,16,17,18,28}. The roots and leaves of *S. cayenensis* are utilized in Northern Brazil¹. A plant of the same genus, *Stachytarpheta jamaicensis*, found in tropical and subtropical regions is also used to treat dysentery and intestinal worms^{24,30}. The entire *P. punctatum* plant is used to treat dysentery in Central and South America^{10,28}. The leaves of *E. uniflora* are used in tropical and subtropical regions^{1,30}. The aerial portion of *A. squamatus* is used in Southern Brazil²².

Material and Method

The plants were collected between September 1991 and January 1992, after which the leaves were dried at room temperature and the BAE prepared by an infusion of 16.67 g of dried leaves in one litre of Tyrode solution or water (similar to the infusion used by people). Adult male Wistar rats

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(150 - 200g) in fasting (24 h) were used to investigate the transport of water, and were sacrificed by cerebral concussion. The abdomen was opened, and the intestine separated in the following portions: duodenum, jejunum, ileum and colon. These portions were everted and washed with Tyrode solution. The flow of water was determined as described by Baldissarotto et al.² To verify the "in vitro" effect of the plants the BAE was placed in the infusion, in contact with the intestinal mucosa. The flow of water was expressed as ml of water transferred from mucosa to serosa (negative values) or serosa to mucosa (positive values) in function of the weight of the tissue (duodenum, jejunum, ileum or colon) in g during 1 h (ml/g tissue.h). An adaptation of the method described by Janssen and Jageneau¹⁵ was used to investigate the gastrointestinal propulsion. Mice (15 - 45 g) in fasting (24 h) were fed a solution of 0.1 ml BAE per 10g live weight, that contained a 10% charcoal suspension as an indicator of gastrointestinal propulsion, by gastric intubation. The control group received the same treatment, but the BAE was substituted for water. Forty-five minutes later, the mice were sacrificed, the gastrointestinal tract excised, from cardia to anus, and carefully laid out for measurement of the distances travelled by the charcoal. The gastrointestinal propulsion was expressed as fractional values of the distance travelled by the charcoal in relation to the total length of the intestine. These fractional values were used because the total length of the intestines of mice was variable.

All values are expressed as the mean \pm SE, and the t-Student Test was used to verify the statistical significance of the difference between means (control and with BAE).

Results

The flow of water was from serosa to mucosa (secretion) in the control group. The BAE of *P. guajava* increased the absorption of water in the colon, but there was no alteration of the flow of water in the other portions. The BAE of *S. cayenensis* did not change the transport of water in relation to the control group in the portions analysed. The BAE of *E. uniflora* increased the absorption of water in all portions, except the jejunum. The absorption of water increased in all portions when the BAE of *A. squamatus* was used. The BAE of *P. punctatum* increased the absorption of water in the ileum, but there was no

change in the flow of water in other portions (Figure 1A and B, Table 1).

All BAE tested, except that of *P. punctatum*, reduced the gastrointestinal propulsion in relation to that of the control group (Figure 2 and Table 2).

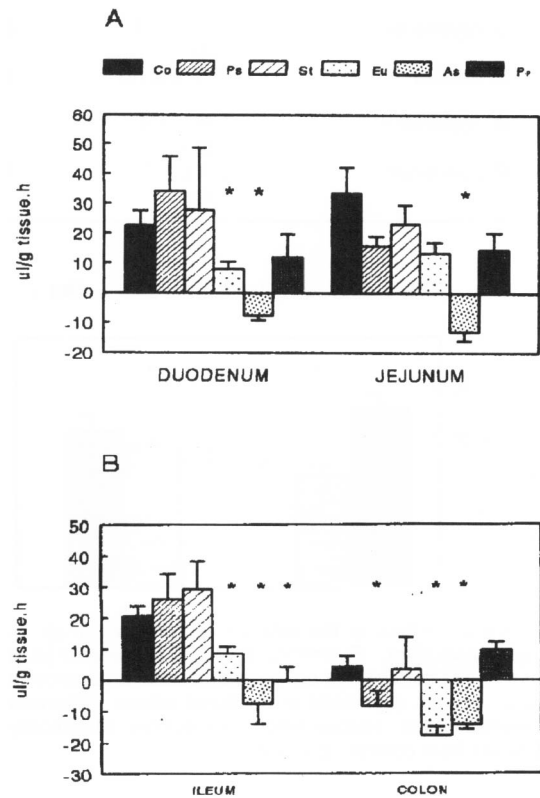


Figure 1 - Effect of the BAE of *P. guajava* (P.g), *S. cayenensis* (S.c), *E. uniflora* (E.u), *A. squamatus* (A.s) and *P. punctatum* (P.p) on the transport of water in the different portions of the intestine of rats.

A - Duodenum and jejunum

B - Ileum and colon

statistically different from control * p < 0.05

Discussion

The viscosity of the faecal bolus basically depends on the absorption of water and the intensity of the gastrointestinal propulsion. A decrease in the absorption or hypersecretion of water and a higher intestinal motility which decreases the solidity of the faeces was observed in diarrhoea¹². This change in the flow of water is due to an increase in the secretion of Cl⁻ or HCO₃⁻ and an inhibition of the absorption of Na⁺ and Cl⁻. To be considered as having an antidiarrhoeic effect, a drug must produce an inverse diarrheal effect, i.e., it must decrease the

Table 1 - Effect of the BAE of *P. guajava*, *S. cayenensis*, *E. uniflora*, *A. squamatus* and *P. punctatum* on the transport of water in the different portions of the intestine of rats. Number of experiments between parenthesis.

Plant	Flow of water (ul/g tissue.h)			
	Duodenum	Jejunum	Ileum	Colon
Control	22.7 ± 5.0 (7)	33.5 ± 8.6 (9)	20.6 ± 3.2 (7)	4.4 ± 3.4 (7)
<i>P. guajava</i>	34.2 ± 11.5 (5)	15.8 ± 3.3 (5)	26.3 ± 7.9 (5)	-8.3 ± 4.7 (6)
<i>S. cayenensis</i>	27.9 ± 20.9 (4)	23.3 ± 6.4 (5)	29.1 ± 9.2 (6)	3.5 ± 10.3 (6)
<i>E. uniflora</i>	8.1 ± 2.5 (4)	13.5 ± 3.5 (4)	8.5 ± 2.5 (6)	-17.5 ± 2.6 (5)
<i>A. squamatus</i>	-7.76 ± 1.4 (5)	-13.1 ± 3.0 (5)	-7.7 ± 6.3 (5)	-14.2 ± 1.4 (6)
<i>P. punctatum</i>	12.0 ± 7.7 (4)	14.6 ± 5.5 (4)	-0.2 ± 4.5 (4)	9.7 ± 2.7 (3)

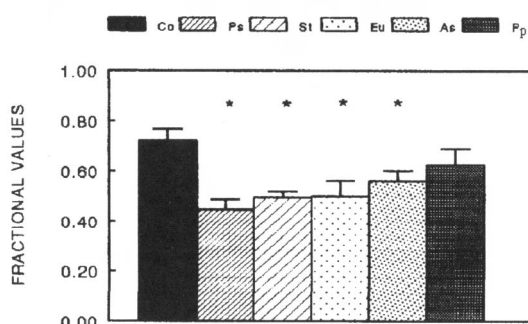


Figure 2 - Effect of the BAE of *P. guajava* (P.g), *S. cayenensis* (S.c), *E. uniflora* (E.u), *A. squamatus* (A.s) and *P. punctatum* (P.p) on gastrointestinal propulsion in mice. Results expressed in fractional values (distances travelled by the charcoal/length of intestine). Statistically different from control * p < 0.05

secretion (or increase the absorption) of water and reduce the intestinal motility.

Field studies of the World Health Organization have demonstrated that the oral rehydration therapy (ORT) is effective in the treatment of all diarrhoeas¹⁹. However, the availability of ORT, especially in poor Third World countries, is low. By 1989, the number of countries that used the ORT was 60. Poorer countries, where the diarrhoeas are the main cause of mortality, may not be able to produce the oral rehydration salts or distribute them¹⁸. On the other hand, the medicinal plants that could be used to treat diarrhoea (for example, all the plants utilized in this experiment) are frequently of easy access and can be obtained free of charge.

The leaves of the guava, *P. guajava*, have been used as folk remedies in the areas where it grows. In some places the leaves are chewed for the relief of discomfort and pain associated with the gas-

troenteritis of diarrhoea, as well as for stopping it. The same effect can be obtained using a decoction of the leaves, bark of the stem or root¹⁷. In South-East Asia, the leaf is given to the giant thorny stick insect, *Hepterapteryx dilata* or other insects, and the faeces are collected in dry pellet form. These pellets are mixed with hot water to make a pleasantly flavoured wine-coloured drink, which is claimed to be efficacious in the treatment of acute diarrhoeas¹⁷.

The leaf of this plant contains approximately 10% tannin^{7,20,21} and also quercetin²⁶. Plants that have tannins in their composition can present an anti-diarrhoeic effect, since these substances precipitate the proteins of the enterocytes, reducing the peristaltic movements and the intestinal secretions. The layer formed by the precipitate of proteins on the mucosal surface of the enterocytes also inhibit the development of micro-organisms, thus explaining the antiseptic action of the tannins, which contributes to the treatment of diarrhoea⁸. Quercetin is the most frequent of all flavonoids¹³, and inhibits the release of acetylcholine in the guinea-pig's ileum and the synthesis of prostaglandins²⁹. In man, prostaglandins cause

Table 2 - Effect of the BAE of *P. guajava*, *S. cayenensis*, *E. uniflora*, *A. squamatus* and *P. punctatum* on gastrointestinal propulsion in mice. Results expressed in fractional values (distances travelled by the charcoal/length of intestine). Number of experiments between parenthesis.

Plant	Gastrointestinal propulsion (fractional values)
Control	0.72 ± 0.05 (12)
<i>P. guajava</i>	0.45 ± 0.04 (8) *
<i>S. cayenensis</i>	0.50 ± 0.02 (8) *
<i>E. uniflora</i>	0.50 ± 0.06 (8) *
<i>A. squamatus</i>	0.56 ± 0.04 (17) *
<i>P. punctatum</i>	0.63 ± 0.06 (8)

statistically different from control * p < 0.05

intestinal cramps and diarrhoea³¹. Consequently, a drug that decreases the synthesis of prostaglandins could be useful in the treatment of diarrhoea. The extract of leaves of *P. guajava* also inhibits the spontaneous contractions in the ileum of the guinea-pig^{16,17} and the *in vitro* growth of three enterobacteria (*Escherichia coli*, *Salmonella enteritidis* and *Shigella flexneri*)^{4,5}. The antibiotic activity is attributed to two compounds of the extract, guajaverin and psidiolic acid^{3,5}.

The chemical composition of the genus *Stachytarpheta* has never been investigated. Another species of the genus *Stachytarpheta* (*S. indica*) is utilized in the treatment of diarrhoea in Eastern Africa³². Our results also confirm the possibility of the existence of an antidiarrhoeic substance in *S. cayenensis*, since its BAE reduces the gastrointestinal propulsion. The presence of active substances like tannins were also determined in *E. uniflora*³².

Flavonoids were found in the flowers of *A. squamatus*²⁵. Another phytochemical study with the leaves, stem and roots of this plant revealed the presence of tannins¹⁵. *A. squamatus* was the most efficient among the plants studied, as regards its possible antidiarrhoeic effect, since its BAE increased the absorption of water in all portions analysed and reduced the intensity of the gastrointestinal propulsion. These results justify the popular use of *A. squamatus* in the treatment of diarrhoeal diseases in infants in Southern Brazil¹⁵.

P. punctatum has been used in enemas as a treatment for dysentery¹⁰. Several species of the genus *Polygonum*, including *P. punctatum*, contain great amounts of tannins¹⁴. Quercetin and sesquiterpenoids (with antimicrobial activity) were also isolated from the extract of this

species^{11,34}. Aqueous and alcoholic extracts of this plant reduced the effect of ocitocin and acetylcholine in the rat's uterus. This reduction was not observed if the extracts were tannin-free²³. However, Chagas et al⁶ did not find any effect of the aqueous extract of *P. acre* in the same organ.

In the present study, the BAE analysed (except that of *S. cayenensis*) reduced the secretion of some portions of the intestine. It is possible that its effect is due to the presence of tannins in the BAE of *P. guajava*, *E. uniflora*, *A. squamatus* and *P. punctatum*. The reduction of the gastrointestinal propulsion observed with the use of the BAE of *P. guajava*, *E. uniflora* and *A. squamatus* could also be due to the tannins. This effect of the BAE of *P. guajava* is in agreement with the fact that a similar extract of this plant inhibited the spontaneous contractions in the ileum of the guinea-pig^{17,18}. Since the chemical composition of *S. cayenensis* is not known, it is not possible to explain its effect on gastrointestinal propulsion.

The results of this study indicate that the plants analysed have a potential antidiarrhoeic effect. However, more studies must be undertaken on infected animals with varying doses of the same extract. Further pharmacological, toxicological and clinical work on these plants is needed before they can be used as an alternative treatment for diarrhoeas.

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Resumo

Para combater a diarreia muitas vezes as pessoas utilizam extratos de plantas conhecidas popularmente como anti-diarreicas, mesmo sem base científica. Em razão disto, verificou-se o efeito do extrato aquoso bruto (EAB) das folhas da *Psidium guajava* (goiabeira), *Stachytarpheta cayenensis* (gervão), *Polygonum punctatum* (polígono ou pimenta d'água), *Eugenia uniflora* (pitangueira) e *Aster squamatus* (zé-da-silva) no transporte intestinal de água em ratos e na propulsão gastrointestinal em camundongos. Com exceção do EAB de *S. cayenensis*, os demais aumentaram a absorção de água em uma ou mais porções do intestino em relação ao grupo-controle. Todos os EAB testados, com exceção do *P. punctatum*, reduziram o trânsito intestinal em relação ao grupo-controle. Com base nos resultados obtidos conclui-se que os EAB das folhas de *P. guayava*, *S. cayenensis*, *P. punctatum*, *E. uniflora* e *A. squamatus* têm potencial ação anti-diarreica, a ser confirmada em novas investigações em animais infectados por agentes enteropatogênicos.

Diarréia, terapia. Extratos vegetais, farmacologia. Plantas medicinais.