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Afr. J. Biomed. Res. Vol. 23 (May, 2020); 273- 276

Research Article

Effects of *Hedranthera barteri* root extract on Gastric emptying and Intestinal Motility in Wistar rats

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ABSTRACT

Hedranthera barteri leaf extracts have been reported in folk medicine to have laxative properties amongst its many other therapeutic potentials. This study was therefore carried out to investigate the effects of Methanol extract of *Hedranthera barteri* (MEHBR) root on gastric emptying and intestinal motility in albino rats. The methanol extract of *H. barteri* (MEHBR) was obtained by cold extraction and stored at 4°C. Forty-eight female rats weighing (180-200g) were randomly divided into two groups of 24 rats each based on the parameters being assessed (gastric emptying and intestinal motility). Each subgroup was divided into four groups of six rats each as follows: Group 1, the control group, was given normal saline while animals in groups 2, 3 and 4 were treated with 50mg/kg, 100mg/kg and 200mg/kg of MEHBR respectively. Gastric emptying was assessed using the glass beads method and gastrointestinal motility was assessed as a measure of the percentage change in gastrointestinal transit time using the charcoal meal method. A decrease in gastric emptying rate was observed in the rats treated with MEHBR at 50mg/kg ($P < 0.05$) when compared to control rats while values obtained in the 100mg/kg and 200mg/kg MEHBR treated rats indicate a significant increase in gastric emptying rate. Intestinal motility increased in a dose dependent manner with the 50mg/kg, 100mg/kg and 200mg/kg exhibiting percentage gastrointestinal transit time of $47.3 \pm 5.5\%$, $35.7 \pm 5.2\%$ and $23.3 \pm 3.0\%$ respectively. Methanol root extracts of *Hedranthera barteri* decreases gastric emptying rate at low dose and increases gastric emptying at high doses. *H. barteri* also increases gastrointestinal motility in a dose dependent manner with 200mg/kg treatment exhibiting the highest laxative effect.

Keywords: *Hedranthera barteri*, gastric emptying, intestinal motility, glass bead, charcoal

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Received: December, 2018; Accepted: November, 2019

Abstracted by:

Bioline International, African Journals online (AJOL), Index Copernicus, African Index Medicus (WHO), Excerpta medica (EMBASE), CAB Abstracts, SCOPUS, Global Health Abstracts, Asian Science Index, Index Veterinarius

INTRODUCTION

Motility within the gastrointestinal tract can be regarded as motor activity within the gut which mixes luminal content with digestive juices and transports it in an oral to anal direction. Gastrointestinal motility disorders have been observed to represent a high percentage of ailments being reported in the clinics (Chang, 2004). These disorders are often chronic in nature and these can exert a tremendous burden to the individual patient from both the symptoms and an overall decreased quality of life (Halder *et al.*, 2004).

The control of normal gastrointestinal motor function is a complex sequence of events that is controlled by an extrinsic nerve supply from the brain and spinal cord, the nerve plexus within the wall of the gut and the effects of locally released transmitters, such as amines and peptides that alter the excitability of the smooth muscle of the intestine (Guyton and

Hall, 2011). Abnormalities in any of these locations can lead to delayed gastric emptying, a disorder which is often expressed clinically as nausea, vomiting, early or easy satiety, bloating, and weight loss (Camilleri, 2006). The most common gastrointestinal motility disorders include achalasia, esophageal motility disorders, dyspepsia, gastroparesis, chronic intestinal pseudo obstruction, diarrhea, irritable bowel syndrome and chronic constipation (Drossman, 2006).

For centuries, medicinal herbs have been used in traditional medicine to treat a wide range of gastrointestinal ailments such as gastroparesis, dyspepsia, gastritis, peptic ulcer disease (PUD), diarrhea, ulcerative colitis (Onasanwo *et al.*, 2013). *Hedranthera barteri*, HB (Family: Apocynaceae) is a shrub found in damp situations of the closed forest in Ghana, North and South Nigeria, West Cameroon and Zaire (Congo Brazzaville). It has been used in folklore to prevent abortion in women (Thomas, 1910), treat gonorrhoea and suppress painful tumor (Ainslie, 1937). Its anti-nociceptive,

anti-inflammatory, anti-malarial and antibacterial activities have also been reported (Chukwujekwu *et al.*, 2005; Onasanwo and Elegbe, 2006; Onasanwo *et al.*, 2008). The plant has been reported to be rich in alkaloids like amataine, beninine, goziline, owerreine, subessiline, isoquinoline and vobstusine (William and Li, 1970). It has been suggested that the beta-sitosterol present in HB may be partly responsible for its anti-inflammatory activities (Onasanwo *et al.*, 2008). It has also been suggested that *Hedranthera barteri* root extracts may possess laxative properties. However, to the best of our knowledge this has not been scientifically investigated. This study was designed to investigate the effects of methanol extract of *Hedranthera barteri* (MEHBR) root on gastric emptying and intestinal motility in albino rats.

MATERIALS AND METHODS

Plant materials and Extraction: *Hedranthera barteri* roots were obtained from F.R.I.N. Ibadan. The roots of *Hedranthera barteri* (HB) were chopped into small pieces, air dried and ground into its powdery form. This powdered form of HB (6.3kg) was percolated in 100% hexane for 48 hours and then filtered. The filtrate was dried using the rotary evaporator. The residue from this process was air dried for forty eight (48) hours and soaked again in 100% methanol for another forty eight (48) hours and then filtered. The filtrate obtained was also subjected to evaporation using the rotary evaporator to give the methanol extract of *Hedranthera barteri* roots (MEHBR). The methanol extract (MEHBR) obtained was stored at 4°C until use (Onasanwo *et al.*, 2010). The extract was prepared as suspensions with 2.5% tween20 and normal saline and administered orally to all treatment groups at a 50mg/kg, 100mg/kg and 200mg/kg.

Phytochemical screening: Preliminary phytochemical screening of the powdered root was assessed for the presence of alkaloids, cardenolides, flavonoids and saponins (Sofowora, 1993)

Animal Grouping: Forty-eight (48) Wistar rats weighing 180-220g were purchased from the Central Animal House, College of Medicine, University of Ibadan, Ibadan. Animals were allowed to acclimatise for a period of two weeks prior to experimental procedures, fed daily with standard rats, allowed free access to drinking water and maintained according to the guidelines and regulations set for the use of laboratory animals by the University of Ibadan. Animals were randomly divided into two groups of 24 rats each based on the parameters being assessed (gastric emptying and intestinal motility). Each subgroup was divided into four groups of six rats each as follows: Group 1, the control group, was given normal saline while animals in groups 2, 3 and 4 animals were treated with 50mg/kg, 100mg/kg and 200mg/kg of MEHBR, respectively (Onasanwo *et al.*, 2010). All animals were fasted for 24hrs prior to the beginning of the experiment and all treatments were administered orally using an oral cannula.

Gastric Emptying: Gastric emptying rate was assessed as described by Wang *et al.*, (2001). Briefly, glass beads (Sigma), 1mm in diameter, were used as non-digestible, non-absorbable

solid markers. The animals were fasted for 20 hours and thereafter given their individual treatments. One hour after receiving their treatments each rat was fed orally with 50 glass beads in physiological saline solution (3ml/kg) using a gastric catheter. Two hours later, the rats were sacrificed, the stomach was exposed and the small intestine was equally divided into 10 segments. The glass beads in the stomach and in each intestinal segment were counted. The gastric emptying was expressed as the ratio of the number of glass beads in the small intestine to that counted from the entire gastrointestinal tract.

$$\text{Gastric emptying} = \frac{\text{Number of glass beads in small intestine} \times 100}{\text{Entire gastrointestinal tract}}$$

Intestinal Motility: This was assessed as measure of the gastrointestinal transit time using the charcoal meal method. Charcoal meal marker was freshly prepared by dispersing 10% (w/v) activated charcoal in 5% (w/v) gum acacia mucilage in distilled water and triturated well. Each rat received 4% charcoal meal (10ml/kg p.o.) orally through a metal oral cannula 1 hr after their respective treatments. After 10min, animals were sacrificed by cervical dislocation, the abdomen was then cut open; the leading marker was identified and tied immediately with a cotton thread to avoid movement of the marker. The entire length of the small intestine was isolated by cutting at the pyloric and ileocecal ends. The distance travelled by charcoal meal and the total length of the intestines was measured in cm(s). The gastrointestinal transit time was expressed as percentage (%) of the distance travelled by the charcoal meal to length of the intestine (Sandhiya *et al.*, 2008; Tembhumne and Sakarkar, 2009).

$$\% \text{ Transit} = \frac{\text{Distance travelled by charcoal meal} \times 100}{\text{Total length of intestine}}$$

Statistical Analysis: All values are expressed as mean \pm SEM and one-way analysis of variance (ANOVA) was used to access the level of statistical significance at $p < 0.05$

RESULTS

Phytochemical Screening of *Hedranthera barteri*: The phytochemical screening of *H. barteri* revealed the presence of alkaloids, cardenolides and flavonoids. The presence of anthraquinones, saponins and tannins was however not established (Table 1).

Effect of MEHBR on Gastric emptying rate: In control animals, the observed gastric emptying rate was 28.7%. Animals treated with MEHBR at 50mg/kg, 100mg/kg and 200mg/kg exhibited percentage gastric emptying rates of 53.3%, 15% and 14.7%, respectively. These values indicate a decrease in gastric emptying rate in the rats treated with MEHBR at 50mg/kg ($P < 0.05$) when compared to control rats while values obtained in the 100mg/kg and 200mg/kg MEHBR treated rats indicate a significant ($P < 0.05$) increase in gastric emptying rate (Table 2).

Effect of MEHBR on intestinal motility: In animals treated with 50mg/kg, 100mg/kg and 250mg/kg MEHBR, a decrease equivalent to 9.56%, 33.12% and 55.26% in percentage

gastrointestinal inhibition respectively was observed when compared with control animals. This decrease in inhibition was dose dependent with the 100mg/kg and 200mg/kg treatment groups exhibiting the highest laxative effect (Figure 1).

Table 1:
Phytochemical screening of *Hedranthera barteri* roots (MEHBR)

Test			
Alkaloid test	Dragenduff's	Meyer's	Wagner's
	Positive	Positive	Positive
Cardenolides test	Keller-Killiani	-	-
	Positive	Positive	-
Anthraquinones test	Chloroform/Ammonia	-	-
	Negative	-	-
Saponins test	Frothing	-	-
	Negative	-	-
Tannins test	Ferric Chloride	-	-
	Negative	-	-
Flavonoid	Magnesium turning/ Conc. H ₂ SO ₄	-	-
	Positive	-	-

Table 2:
Gastric emptying rate in control and MEHBR treated rats

Treatment Groups	Gastric Emptying rate (%)
Control (Vehicle)	28.7 ± 1.7
50mg/kg (MEHBR)	53.3 ± 6.7*
100mg/kg (MEHBR)	15.0 ± 1.5*
200mg/kg (MEHBR)	14.7 ± 1.3*

Data represent mean ± S.E.M of 6 rats in each group. *P<0.05 indicates values that are significantly different from control values.

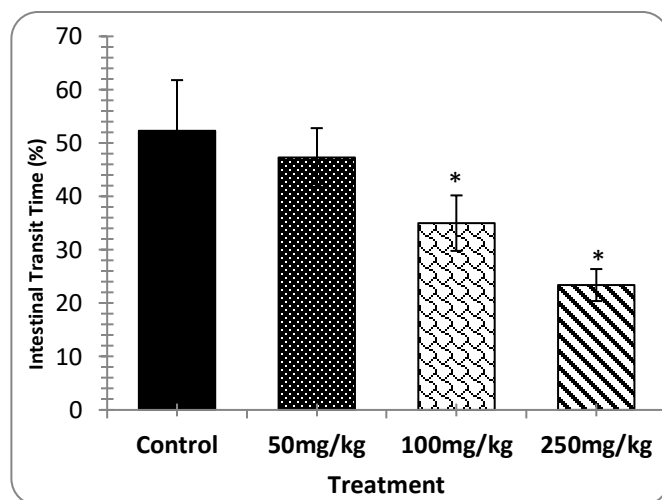


Figure 1:
Effect of methanol extract of *Hedranthera barteri* roots (MEHBR) on intestinal motility.
Data represent means ± S.E.M of 6 rats in each group. *P<0.05 indicates values that are significantly different from control values

DISCUSSION

Gastric motility disorders are often chronic in nature and can cause a tremendous burden to the individual patient from both the symptoms and an overall decreased quality of life (Halder et al., 2004). This study shows a dose dependent increase in

percentage gastric emptying rate and intestinal transit in MEHBR treated rats thus suggesting that at low doses MEHBR may possess anti-diarrhea properties and at high doses MEHBR may exert laxative effects.

In this study, phytochemical screening of the crude extract of *Hedranthera barteri* roots showed the presence of alkaloids and flavonoids, which can affect the electrical activities of the smooth muscles of the gastrointestinal wall. Francis et al., (2002) and Alexander et al., (2008) reported that alkaloids in addition to causing dryness of the mucosa in the upper gastrointestinal tract also antagonize the muscarinic acetylcholine receptors thus preventing the binding of acetylcholine. The blockade of acetylcholine binding to its receptor would lead to a reduction in peristaltic and segmentation movements in the small intestine, and thus reduce gastric motility. In addition to this, flavonoids have been reported to exert anti-diarrheal effects by their ability to inhibit intestinal motility and hydro-electrolytic secretion (Al-Mamoori, 2011). In vitro and in vivo experiments have also shown that flavonoids are able to inhibit the intestinal secretory response induced by prostaglandins E2 (Di Carlo et al., 1993). It is, therefore, not unlikely that the reduction in gastric emptying observed at 50mg/kg MEHBR may be as a result of the combined effect of its alkaloid and flavonoid component at low concentrations.

Conversely, increased concentrations of alkaloids have been reported to cause increased electrical activity of membranes leading to increased intestinal motility (Alexander et al 2008). This may account for the increased intestinal motility noted in the 100mg/kg and 200mg/kg treatment groups respectively

In conclusion, methanol extract of *Hedranthera barteri* at low doses of 50mg/kg may possess anti-diarrhea effects and at high doses of 100mg/kg and 200mg/kg, may exert laxative effects.

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