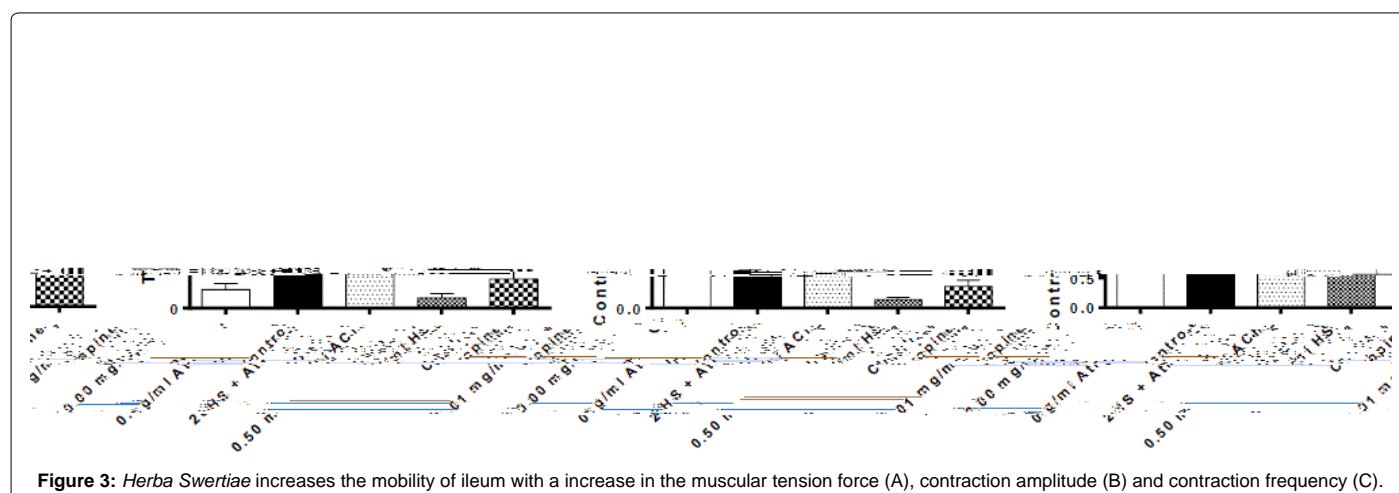
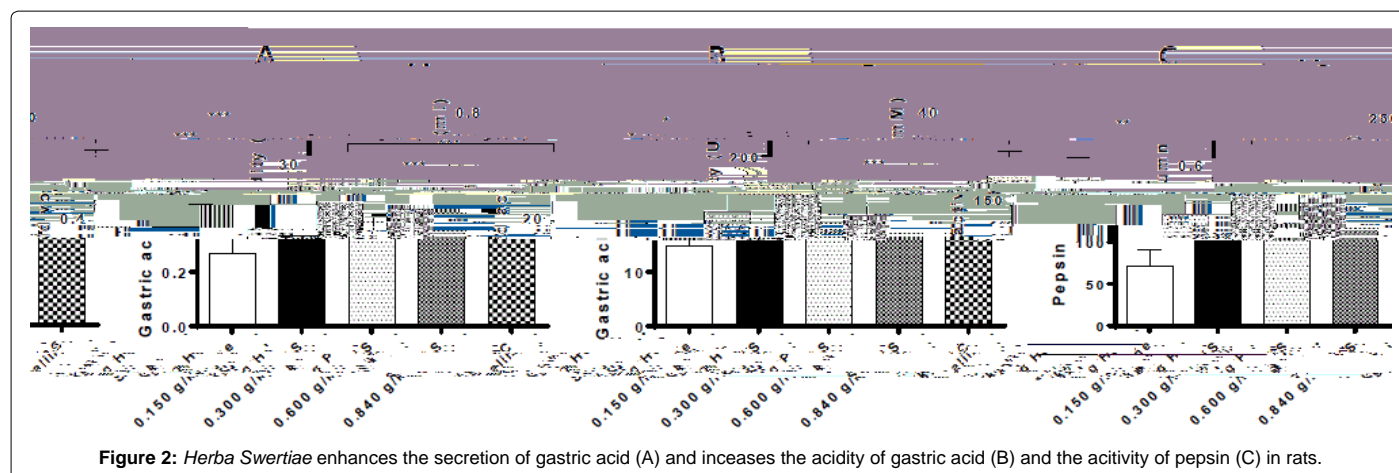


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system *in vivo*, we performed *ex vivo* study to test the effect of *Herba Swertiae* on isolated ileum of guinea pig with a focus on muscular tension force, contraction amplitude and frequency. Treatment of guinea pig with 20 mg/ml *Herba Swertiae* enhanced the muscular tension force, contraction amplitude and frequency in isolated ileum (Figures 3A-3C). Compared to the control group, *Herba Swertiae* (20 mg/ml × 2 ml) increased 2.2-fold in the muscular tension force ( $P < 0.05$ ; Figure 3A); ACh (0.01 mg/ml × 0.1 ml) enhanced 8.5-fold in the muscular tension force ( $P < 0.001$ ; Figure 3A); atropine (0.5 mg/ml × 0.4 ml) decreased 45.2% in the muscular tension force ( $P > 0.05$ ; Figure 3A). Of note, *Herba Swertiae* restored atropine-minished muscular tension force with 2.9-fold increase, compared to atropine-treated alone ( $P < 0.05$ ; Figure 3A). For the contraction amplitude, *Herba Swertiae* treatment resulted in a significant increase with 2.9-fold ( $P < 0.001$ ), whereas atropine treatment led to a 81.1% decrease ( $P < 0.05$ ), compared to the control group (Figure 3B). *Herba Swertiae* antagonized atropine-reduced contraction amplitude with 2.5-fold increase, compared to atropine-treated alone ( $P > 0.05$ ; Figure 3B). In addition, although there was slight increase in the contraction frequency in the isolated ileum when treated with ACh and *Herba Swertiae*, there was no significant alteration ( $P > 0.05$ , Figure 3C). However, atropine dramatically increased the contraction frequency 49.6-fold ( $P < 0.001$ ; Figure 3C). Notably, *Herba Swertiae* abolished the increasing effect of atropine on contraction frequency and normalized it (Figure 3C). In aggregate, *Herba Swertiae* exerts a beneficial effect on the mobility of ileum.

## D

A large line of evidence shows that herbal medicines and natural products have been the most productive source for the drug discovery and development and there is a wealth of evidence showing the application of herbal medicines and natural products for body function management and ailments treatment [1,2,4,9,10]. Owing to the multiple bioactive components in herbal medicines and natural products, it can explain the multiple targets effect in their medical applications; on the other hand, it may contribute to the unwanted side effects. Therefore, it needs to fully evaluate the beneficial effect and side effect of herbal medicines and natural products to improve their therapeutic effect and avoid unfavorable effect in clinical practice.

*Herba Swertiae* is traditionally used for the treatment of diarrhea, poor appetite, hypochondriac pain, and jaundice that can be ascribed to the mechanism of actions of the clearance of damp-heat and the strengthening of the stomach [6,7]. In the present study, we observed potent beneficial effects of *Herba Swertiae* on gastrointestinal system *in vivo*. In clinical settings, the aberrations in gastric emptying and intestinal propulsion are the common causes to gastrointestinal disorders [11,12]. Our study showed a promoting effect of *Herba Swertiae* on gastric emptying and intestinal propulsion in mice, which is similar to the effect of domperidone. It has been demonstrated that domperidone stimulates gastric muscle contraction by antagonizing the inhibitory effects of dopamine on postsynaptic cholinergic neurons

[13]. Therefore, our findings suggest that *Herba Swertiae* may exert similar effect to domperidone on gastrointestinal system via its multiple active components; however, it needs to be further validated in future studies regarding the underlying mechanisms and molecular targets for beneficial effect on the gastrointestinal system.

Furthermore, our findings showed that *Herba Swertiae* dose-dependently enhanced the secretion and the acidity of gastric acid and the activity of pepsin in rats. Such increasing effect is comparable to that of the positive control, which renders *Herba Swertiae* may be a potent . 8(e)12.1(n)edeng (en-6n ✚ Tw -44 11(v)8(e co)1n-6n ✚ Tw -8218i)smt