

In-Vitro Litholytic Activity of a Polyherbal Extract of Boerhavia diffusa, Celosia argentea and Plumeria rubra Against Urinary Calculi

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Abstract: The present study investigated the in-vitro litholytic potential of aqueous extracts of Boerhavia diffusa, Celosia argentea and Plumeria rubra and optimized their polyherbal combination for dissolution of urinary calculi. Human kidney stones obtained from a hospital were weighed and morphologically evaluated before and after exposure to aqueous extracts. Preliminary screening showed reduction in stone weight and diameter after 24 h. Two combinations were subsequently examined: Combination A (B. diffusa:C. argentea:P. rubra = 2:1:1) and Combination B (4:1:1). Combination B produced greater dissolution after 24 h and was selected for further investigation. In a six-week dissolution experiment, aqueous extracts were evaluated against cystine, carbapatite and uric acid calculi using physiological saline as the control environment. The findings documented progressive dissolution, with more than 15% weight loss reported from the second week for all three calculi types and a 4.8% weight reduction in the saline control. The results support further pharmacological and formulation-based investigation of the selected polyherbal combination.

Keywords: Litholytic activity; urinary calculi; Boerhavia diffusa; Celosia argentea; Plumeria rubra; polyherbal extract; dissolution.

I. INTRODUCTION

Urolithiasis is characterized by formation of calculi within the urinary system. Stone composition, size and physicochemical characteristics can influence dissolution and passage. The thesis work underlying this article evaluated three medicinal plants traditionally associated with kidney-stone management and investigated their ability to dissolve preformed calculi. Litholytic activity was defined in the study as the ability of an agent to dissolve or reduce urinary stones.

The experimental approach consisted of preliminary screening of individual aqueous extracts, optimization of a three-plant combination, and systematic evaluation against cystine, carbapatite and uric acid calculi. The optimized ratio was subsequently carried forward to in-vivo work; the present article focuses specifically on the in-vitro component.

II. MATERIALS AND METHODS

2.1 Plant materials and preliminary screening

Aqueous decoctions/extracts of B. diffusa, C. argentea and P. rubra were prepared as described in the thesis. Human kidney stones were collected from a hospital, weighed and measured. Preweighed stones were exposed to aqueous decoction while a second portion served as control. Flasks were maintained at 37°C with intermittent shaking. After 24 h, stones were recovered, dried for 18 h at 40°C and reweighed; diameter and morphology were also observed.

Extract	Weight before	Weight after 24 h	Diameter before	Diameter after 24 h
B. diffusa	80 mg	70 mg	6.0 mm	5.0 mm
C. argentea	70 mg	62 mg	5.0 mm	3.9 mm



P. rubra	95 mg	83 mg	8.0 mm	7.1 mm
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2.2 Optimization of polyherbal ratio

Two ratios were prepared from the three selected plants: Combination A, containing 2 parts B. diffusa with 1 part each of C. argentea and P. rubra seed pod; and Combination B, containing 4 parts B. diffusa with 1 part each of C. argentea and P. rubra seed pod. Both combinations were tested for stone dissolution.

Combination	Initial weight	Weight after 24 h	Initial diameter	Diameter after 24 h	Dissolution
A (2:1:1)	78 mg	70 mg	6.1 mm	5.6 mm	10.25%
B (4:1:1)	80 mg	65 mg	6.0 mm	4.9 mm	18.75%

2.3 Systematic dissolution study

The aqueous polyherbal extract was prepared by mixing the three plants in a 4:1:1 proportion and boiling for 30 min in 100 mL physiological saline (9 g NaCl/L). After filtration, 60 mL extract was placed in a glass Erlenmeyer flask. Calculi were suspended in the extract at room temperature using a permeable bag. Calculi were dried for 18 h at 40°C and weighed at weekly intervals for six weeks. Three triplicates were carried out for each experiment. Percentage dissolution was calculated as $[(\text{initial weight} - \text{final weight}) \times 100] / \text{initial weight}$.

III. RESULTS AND DISCUSSION

The preliminary experiment demonstrated measurable dissolution with each individual aqueous extract. B. diffusa produced a 10 mg reduction in stone weight and 1 mm reduction in diameter after 24 h. C. argentea produced an 8 mg weight reduction and a 1.1 mm reduction in diameter, whereas P. rubra produced a 12 mg weight reduction and a 0.9 mm reduction in diameter. These findings formed the basis for optimization of a combined preparation.

Combination B showed 18.75% dissolution after 24 h compared with 10.25% for Combination A. The corresponding reduction in diameter was from 6.0 to 4.9 mm for Combination B and from 6.1 to 5.6 mm for Combination A. Based on the thesis criteria, Combination B was selected for subsequent in-vitro and in-vivo investigations.

Week	Cystine calculi dissolution (%)	Carbapatite calculi dissolution (%)	Uric acid calculi dissolution (%)
0	0	0	0
1	10.25	9.86	9.51
2	18.45	19.76	17.81
3	28.95	27.65	26.98
4	35.78	39.40	38.85
5	58.98	62.86	63.82
6	70.75	78.35	73.45

The six-week data showed progressive dissolution for all three calculus types. By week 6, the reported dissolution was 70.75% for cystine, 78.35% for carbapatite and 73.45% for uric acid calculi. The thesis reported a 4.8% weight reduction for the physiological saline control. The progressive pattern suggests that exposure duration was an important determinant of the observed in-vitro effect.

The present findings are experimental and do not establish clinical efficacy. The study used ex-vivo human calculi and aqueous plant preparations under laboratory conditions; therefore, stone dissolution in patients cannot be inferred directly. Nevertheless, the results provide a basis for standardization of the optimized combination and for further pharmacological evaluation.



IV. CONCLUSION

Aqueous extracts of *B. diffusa*, *C. argentea* and *P. rubra* demonstrated measurable in-vitro litholytic activity. The 4:1:1 polyherbal combination showed greater 24-h dissolution than the 2:1:1 combination and was selected for further study. Systematic testing demonstrated progressive dissolution of cystine, carbapatite and uric acid calculi over six weeks. Further work should characterize the active constituents, clarify mechanisms of dissolution and establish reproducibility using appropriately standardized preparations.

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