



Inhibition of Mineralization of Urinary Stone Forming Minerals by Medicinal Plants

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Abstract: The inhibition of mineralization of urinary stone forming minerals by medicinal plants *i.e.* *Achyranthes aspera* Linn, *Passiflora leschenaultii* DC, *Solena amplexicaulis* (Lam.) Gandhi, *Scoparia dulcis* Linn and *Aerva lanata* (Linn.) been investigated. The inhibition efficiency was studied. Increased intake of fruits juice and seed extract of our plants would be helpful in urinary stone prophylaxis.

Keywords: Urinary Stone, Urolithiasis, Medicinal plant, Inhibition

Introduction

A number of people suffer from problems due to urinary stones (calculi). Areas of high incidence of urinary calculi include the British Isles, Scandinavian countries, Northern Australia, Central Europe, Northern India, Pakistan and Mediterranean countries. Saurashtra region, Gujarat has higher prevalence of urinary stones. According to an estimate, every year 600,000 Americans suffer from urinary stones. In India, 12% of the population is expected to have urinary stones, out of which 50% may end up with loss of kidneys or renal damage. Also, nearly 15% of the population of northern India suffers from kidney stones. Fewer occurrences of urinary calculi are found in southern India, which may be due to regular dietary intake of tamarind.

Kidney stones are the commonest universal complaints¹. Kidney stones modify the victim's behavior with great fear of intense pain and threaten with failure of the kidneys. In modern medicine no satisfactory effective therapy is still available to dissolve or to prevent acetazolamide are available against uric acid and cystine stone, although several drugs / therapies such as thiazides, cellulose phosphate, magnesium oxide and pyridoxine etc. have been tried. On the other hand the traditional system of Indian medicine "Ayurveda" recommends several medicinal plants²⁻⁸ for the treatment of Urolithiasis. Urolithiasis disease exists in 'endemic' proportions in some parts of our country. Urinary stones contain both crystalloid and colloid components. The crystalloid components are mainly calcium oxalate, calcium phosphate, calcium carbonate, magnesium-ammonium phosphate, uric acid and cysteine. In the present work we have estimated the inhibition efficiency of medicinal plants,

i.e. *Achyranthes aspera* Linn (**P1**), *Passiflora leschenaultii* DC (**P2**), *Solena amplexicaulis* (Lam.) Gandhi (**P3**), *Scoparia dulcis* Linn (**P4**) and *Aerva lanata* (Linn.) (**P5**) on the mineralization of calcium oxalate, calcium carbonate and calcium phosphate.

Experimental

Materials and Methods

All the chemicals used were of AR grade. Crystalloid forming solutions, viz., solution of calcium acetate, disodium oxalate, sodium carbonate and trisodium phosphate, were prepared in distilled water.

Plant material for the present work was collected locally and was identified botanically. Leaves were carefully removed from the plants and allowed to dry in the sun light. The dried leaves were made into a powder and extracted with 95% ethanol. The extract was concentrated. The residue was suspended in water. Seed extract was prepared by the following procedure.

Juice of the fruits was extracted with help of an ordinary fruit juicer. The thick juice obtained, were passed through a mesh and then suction filtered through ordinary filter paper. All the juice was used diluted to a known concentration.

Four experimental models namely 'simultaneous flow static model' (S.S.M.), 'simultaneous flow dynamic model' (S.D.M.), 'reservoir static model' (R.S.M.) and 'reservoir dynamic model' (R.D.M.) were designed¹¹. The medicinal plant was collected from hills area and botanically identified⁹. The experiments were carried out in the laboratory. Simultaneous blank experiments were also carried out for evaluating the inhibition efficiency of inhibitor. All the experiments were conducted at room temperature. Percentage efficiency of inhibitor was calculated¹⁰.

Results and Discussion

Inhibition efficiencies of leaves, seeds and fruits of the medicinal plants (**P1-P5**) have been investigated in different models. The results are recorded in Table 1. Study of the tables and charts (Figures 1-5) suggests that the fruit juice and seed extract of the medicinal plants is moderate to good inhibitor of calcium oxalate, calcium carbonate and calcium phosphate mineralization. Sequestering of this insoluble calcium salts by the fruit juice might be due to effective single or mixed ligand chelation by the hydroxyl acids present in them. The hydroxyl acids are expected to form metal ion complexes with calcium. The presence of hydroxyl acids in urine may decrease the amount of ionized calcium available for calcium oxalate precipitate. Relatively poor inhibition of mineralization of calcium oxalate, calcium phosphate and calcium carbonate precipitation by leaves extracts might be due to a higher pK value of carbonic acid leading to replacement and precipitation of calcium salts of inhibitors rather than soluble mixed chelation¹¹. Calcium oxalate is a stubborn constituent of urinary calculi being highly insoluble. It has very poor solubility in the leaves extract as such; however, if the fruit juices are present in the milieu before the formation of calcium oxalate, they may prevent the precipitation of the latter by exerting the specificity of their inhibitor towards calcium ions.

The average inhibition efficiency for all the models is present in the Table 2. The calcium oxalate mineralization is most effective in all the plants. The calcium phosphate mineralization is moderate in all the plants. The effect of inhibition efficiency of leaves extract is very poor in all the cases. A comparative study of different models indicates that the reservoir dynamic model is the most effective one in the inhibition of calcium oxalate

mineralization. This might be due to mass effect. An *ab-initio* presence of large concentration of juice (in the reservoir) leads to minimize the free Ca^{2+} ions for precipitation as insoluble salts. Most of the fruits contain hydroxyl polybasic acids. Our present study suggests that the increased intake of fruits juice and seed extract of our plants would be helpful in urinary stone prophylaxis.

Table 1. Inhibition of (1) Calcium oxalate (2) Calcium phosphate and (3) Calcium carbonate Mineralization by medicinal plants.

S.No.	Plant	Model	Inhibition Efficiency, %			Inhibition Efficiency, %			Inhibition Efficiency, %		
			(1)			(2)			(3)		
			Fruit Juice	Seed Extract	Leaves Extract	Fruit Juice	Seed Extract	Leaves Extract	Fruit Juice	Seed Extract	Leaves Extract
1	P1	SSM	63	66	62	58	56	58	64	59	49
2		SDM	65	60	55	62	58	50	45	42	48
3		RSM	55	58	52	50	54	51	47	44	46
4		RDM	64	78	75	70	77	73	45	48	49
5	P2	SSM	58	55	56	64	66	62	43	44	41
6		SDM	75	78	77	73	71	70	49	42	45
7		RSM	60	59	57	68	67	63	43	44	41
8		RDM	78	79	73	77	75	74	50	49	51
9	P3	SSM	66	68	64	69	61	62	49	55	49
10		SDM	68	72	77	75	74	73	49	48	51
11		RSM	72	71	73	74	77	71	61	58	54
12		RDM	75	73	76	70	69	67	55	54	49
13	P4	SSM	65	69	68	70	71	69	49	50	52
14		SDM	75	77	72	74	70	69	49	48	49
15		RSM	69	68	66	65	67	69	48	47	50
16		RDM	70	71	74	74	73	70	50	51	50
17	P5	SSM	57	68	69	65	67	66	50	51	49
18		SDM	71	73	74	70	73	74	52	53	57
19		RSM	56	55	56	60	61	66	52	55	51
20		RDM	68	68	67	66	67	69	55	52	51

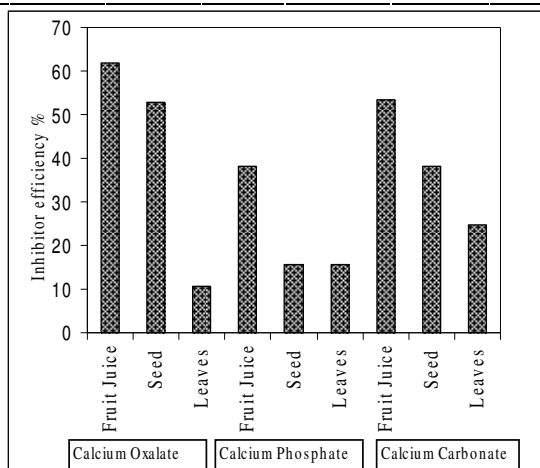


Figure 1. Inhibition Efficiency of *Achyranthes aspera* Linn (P1).

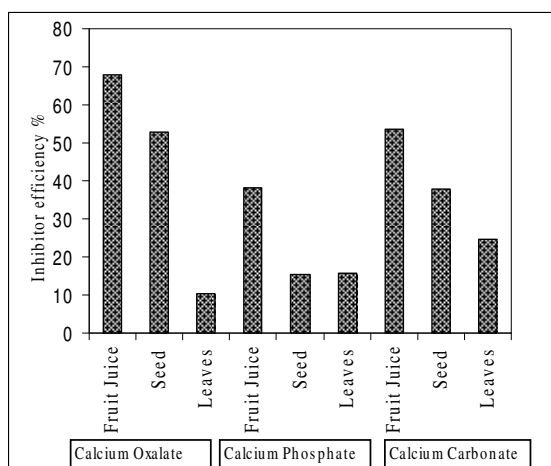


Figure 2. Inhibition Efficiency of *Passiflora leschenaultii* DC (P2).

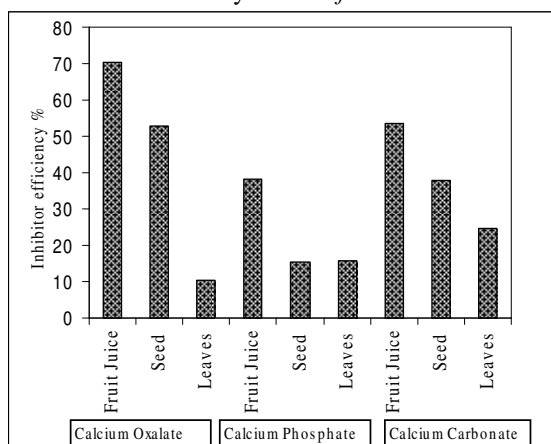


Figure 3. Inhibition Efficiency of *Solena amplexicaulis* (Lam.) Gandhi (P3).

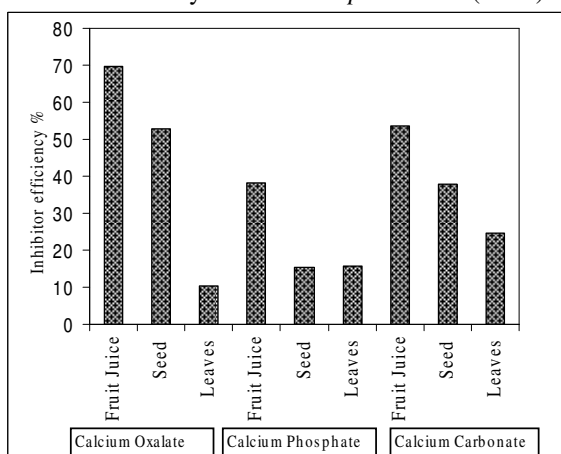


Figure 4. Inhibition Efficiency of *Scoparia dulcis* Linn (P4).

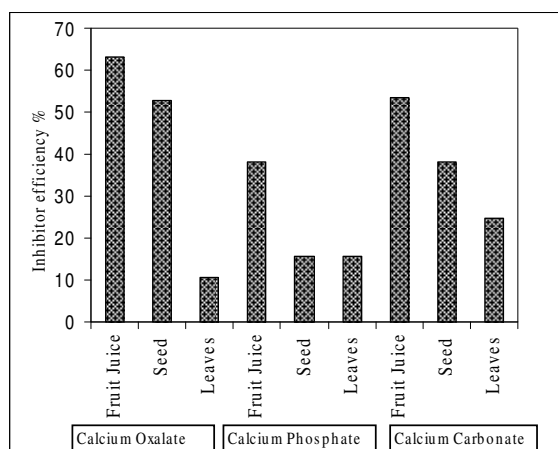


Figure 5. Inhibition Efficiency of *Aerva lanata* (Linn.) (P5).

Table 2. Average inhibition efficiency of all models.

Stone	Plant parts	Inhibition efficiency, %				
		P1	P2	P3	P4	P5
Calcium oxalate	Fruit Juice	61.75	67.75	70.25	69.75	63
	Seed	52.75	52.75	52.75	52.75	52.75
	Leaves	10.5	10.5	10.5	10.5	10.5
Calcium phosphate	Fruit Juice	38.25	38.25	38.25	38.25	38.25
	Seed	15.5	15.5	15.5	15.5	15.5
	Leaves	15.75	15.75	15.75	15.75	15.75
Calcium carbonate	Fruit Juice	53.5	53.5	53.5	53.5	53.5
	Seed	38	38	38	38	38
	Leaves	24.75	24.75	24.75	24.75	24.75

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