IN-Vitro Dissolution of Urinary Stone With Hydroxy Acid, Amino Acid, And Natural Plant Extract

Dr. Ashish Kumar

Assistant Professor, Department of Chemistry, Patna Women's College, Bailey Road, Patna -800001, Bihar, India

E-mail: ashish.che@patnawomenscollege.in

Phone no:- 09708345101, 9308642901

Abstract: The inhibition of mineralization of urinary stone-forming minerals by *Tartaric acid, Glycine, and natural plant extract* has been investigated. The inhibition efficiency of different concentrations was studied. Increased intake of glycolic acid would be helpful in urinary stone prophylaxis. Glycolic acid acts as a protecting agent. It has been suggested that 'protecting agents' perhaps withdraw the metal cation from the solution, and thus increase the
degree of 'supersaturation. It is expected that their addition to a solution containing such ions would cause a reduction in the rate of crystal growth. Crystal growth is a very complex process since both the surface and the supersaturation vary continuously throughout the period of the growth. *The experiment result showed that the Reservoir Dynamic Model(RDM) is more efficient than the Simultaneous Dynamic Model(SDM) model for dissolution of urinary stone*

Keywords: urinary stone; urolithiasis; dynamic models; in vitro inhibition

Introduction:

A number of people suffer from problems due to urinary stones (calculi). In India, 12 % of the population is expected to have urinary stones, out of which 50 % may end up with the loss of kidneys or renal damage. Also, nearly 15% of the population of northern India suffers from kidney stones. The urinary stone contains both crystalloid and colloid components. The crystalloid components are mainly calcium oxalate, calcium phosphate, calcium carbonate, magnesium ammonium phosphate, uric acid, and cystine. Stone formation is apparently related to the level of urinary inhibitors of calculogenesis in urine. Human urine is known to contain some protective compounds called inhibitors. These compounds sequestrate the stone and prevent the supersaturation of urine. In the present work, we have estimated the inhibition efficiency of glycolic acid on the mineralization of calcium oxalate, calcium carbonate, and calcium phosphate. Glycolic acid is easily available, non-toxic, and does not have any side effects.

Experimental

Materials and Methods

Crystalloid forming solutions viz. solution of disodium oxalate, sodium carbonate, and trisodium phosphate were prepared in distilled water. Solution of 0.01 M and 0.1 M *Tartaric acid and Glycine* were prepared in distilled water. Two experimental model[1-2] namely the simultaneous dynamic model (s.d.m) and reservoir dynamic model (r.d.m) were designed[1]. Simultaneously blank experiments were also carried out for evaluating the inhibition efficiency of inhibitors. All the experiments were conducted at room temperature. Percentage efficiency of inhibitor was calculated[4] by using the formula:-

Inhibition Efficiency =

$$\frac{\text{(Wt. of ppt blank set) – (Wt. of ppt. in experiment set)}}{\text{Wt. of ppt. in blank set}} \times 100$$

In order to know the dissolution[5-6] with horse gram the whole calculi were treated with 250 gram of horse gram (kurthi dal) was taken then extract with the help of water(500 ml) was prepared. To the extract 50 ml of 2N HCl was added and then boiled for 10 minutes on water bath and then cooled to room temperature. It was then added to a salt of **$CaCO_3$ and CaC_2O_4 of 0.1 M & 0.01 M** taken in a beaker stirred continuously for 10 minutes. It was then left for 48 hours for dissolution. The difference in the weights before and after the treatment with it gives a clear indication of dissolution of these minerals[3].

Observation Table:-

Table 1:- 0.1 M $CaCO_3$

S.no	Inhibitor	Concentration	Wt. of ppt. (in gram)		Percentage (%) Efficiency	
			SDM	RDM	SDM	RDM
1	Water (Blank)	-	0.80	0.82	-	-
2	Glycine	0.1M	0.37	0.26	53.75%	65.85%
3	Tartaric Acid	0.1M	0.77	0.76	3.75%	7.31%

Table 2:- 0.01M $CaCO_3$

Sl. No.	Inhibitor	Concentration	Wt. of ppt. (in gram)		Percentage (%) Efficiency	
			SDM	RDM	SDM	RDM
1	Water (Blank)	-	0.09	0.03	-	-
2	Glycine	0.01M	0.08	0.01	11.11%	66.66%
3	Tartaric Acid	0.01M	0.04	0.0	55.55%	100.00%

Table 3:- 0.1M CaC_2O_4

Sl. No.	Inhibitor	Concentration	Wt. of ppt. (in gram)		Percentage (%) Efficiency	
			SDM	RDM	SDM	RDM
1	Water (Blank)	-	0.62	0.78	-	-
2	Glycine	0.1M	0.50	0.52	19.35%	33.3%
3	Tartaric Acid	0.1M	0.58	0.55	6.45%	29.4%

Table 4:- 0.01M CaC_2O_4

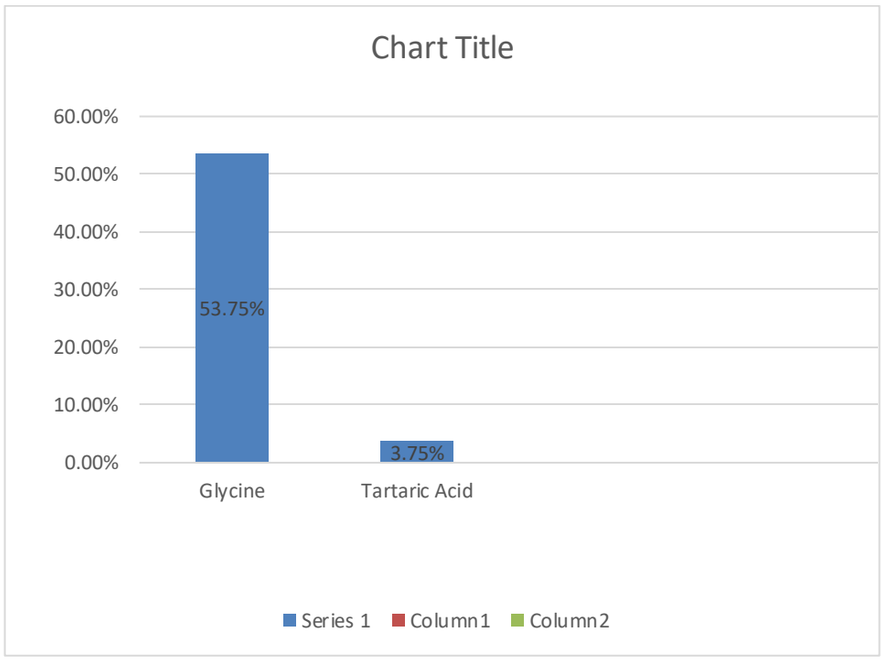
Sl. No.	Inhibitor	Concentration	Wt. of ppt. (in gram)		Percentage (%) Efficiency	
			SDM	RDM	SDM	RDM
1	Water (Blank)	-	0.21	0.09	-	-
2	Glycine	0.01M	0.01	0.01	95.23%	88.8%

3	Tartaric Acid	0.01M	0.01	0.01	95.23%	88.8%

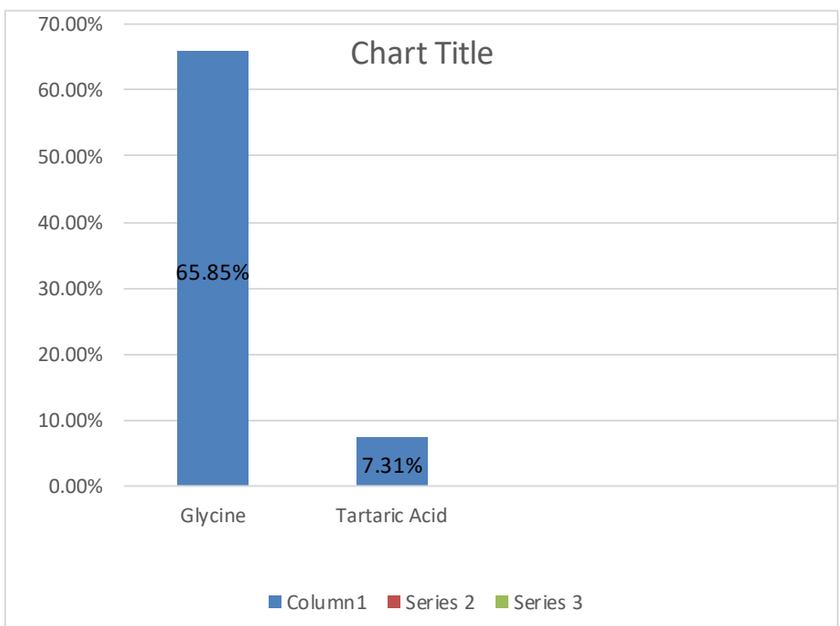
Table 5:- dissolution of urinary stone by Horse gram Extract.

Sl. No.	Sample	Concentration	Time	Wt. of stone (in gram)			% of Dissolution	Inhibitor (100ml)
				Initial	Final	Difference		
1	$CaCO_3$	0.1M	48 hrs.	0.38	0.02	0.36	94.7%	Horse gram Extract (100 ml)
2	$CaCO_3$	0.01M	48 hrs.	0.04	0.01	0.03	75.0%	
3	CaC_2O_4	0.1M	48 hrs.	0.72	0.29	0.43	59.7%	
4	CaC_2O_4	0.01M	48 hrs.	0.05	0.02	0.03	60.0%	

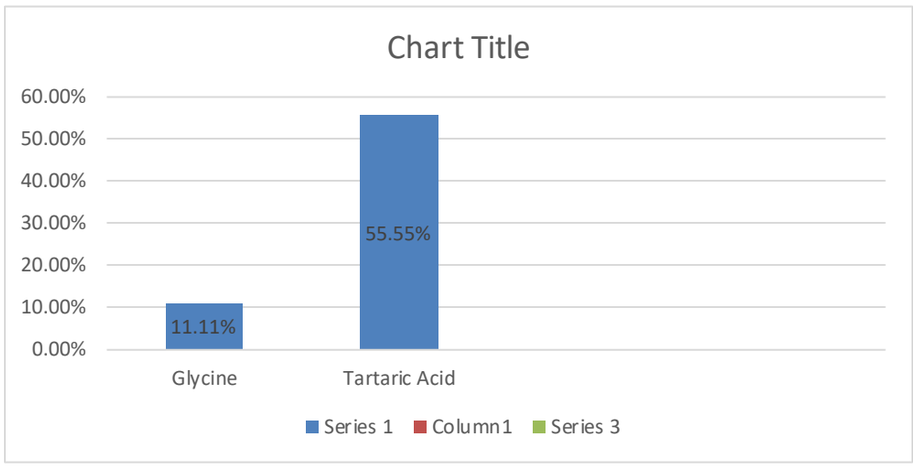
Graph 1:- :- The inhibition efficiency of 0.1 M **0.1M $CaCO_3$** in**Simultaneous Dynamic Model of**



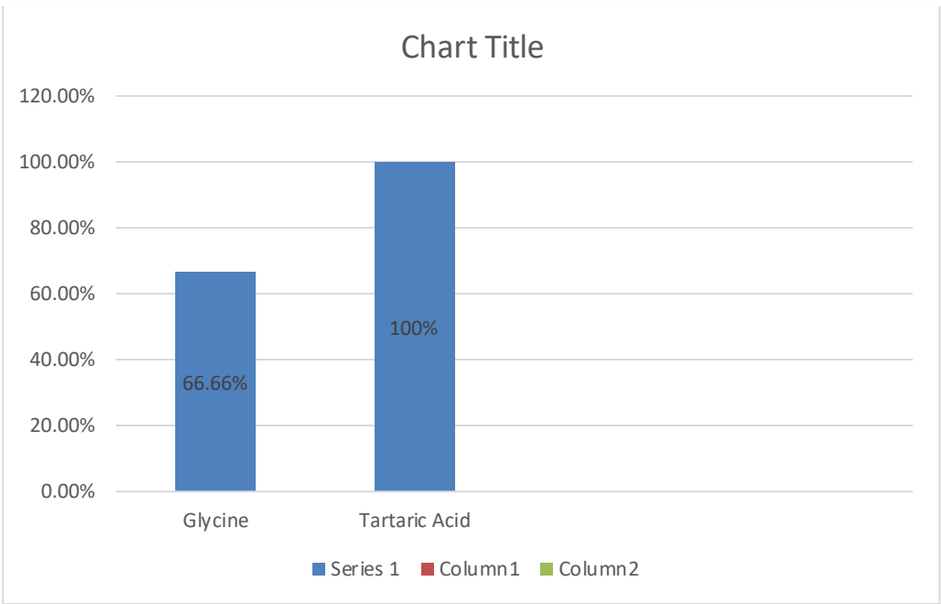
Graph 2:- The inhibition efficiency of 0.1 M **0.1M $CaCO_3$in Reservoir Dynamic Model**



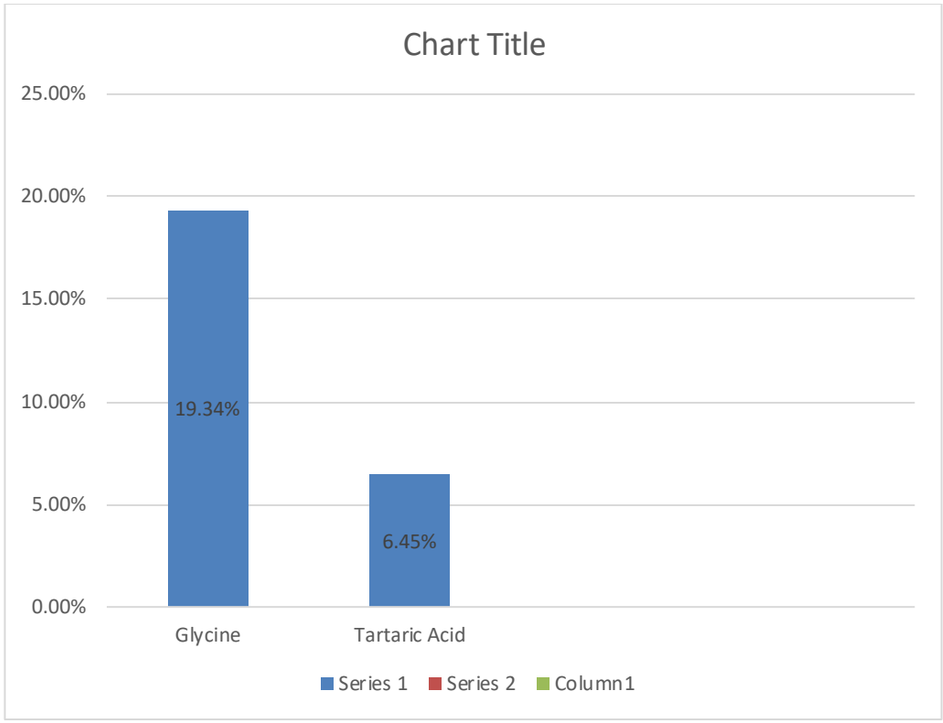
Graph 3:- 0.01M$CaCO_3$ (SDM)



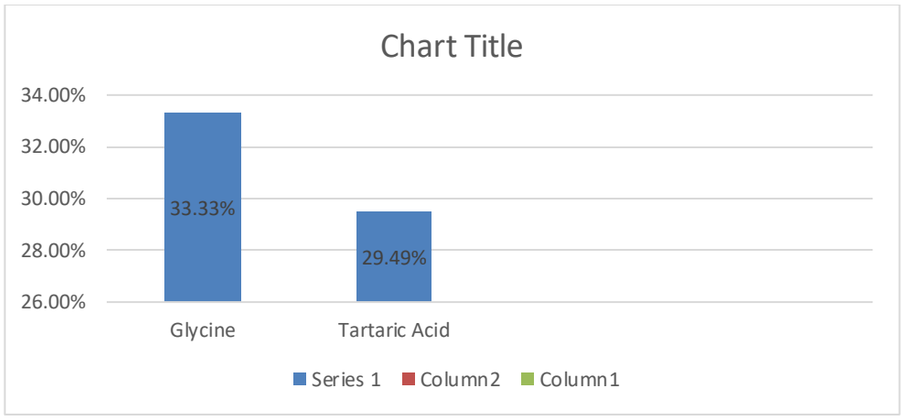
GRAPH 4:- 0.01M $CaCO_3$**(RDM)**



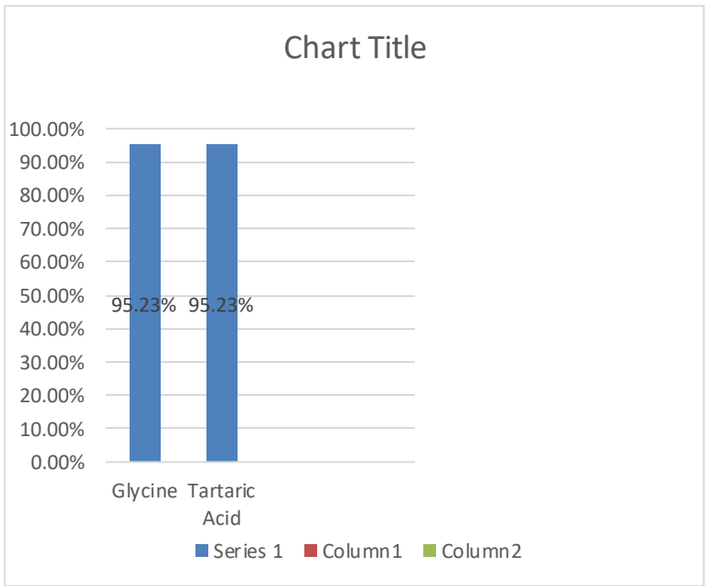
Graph 5:- 0.1M CaC_2O_4(SDM)



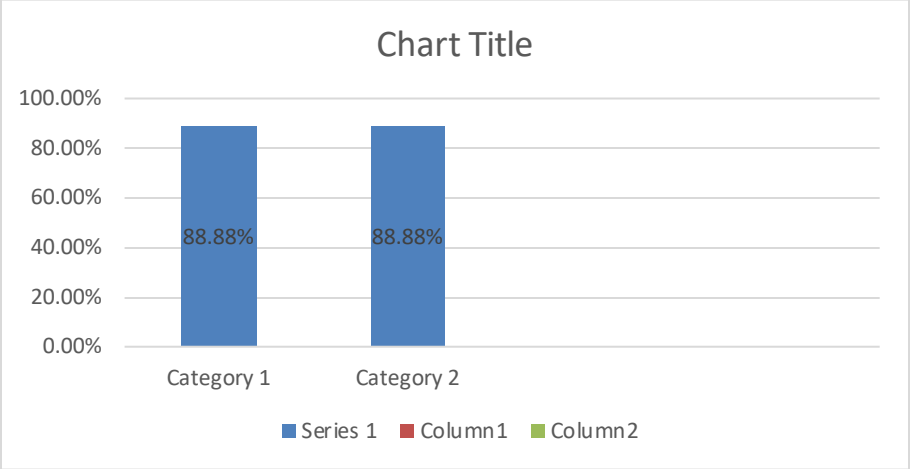
Graph 6:- 0.1M CaC_2O_4(RDM)



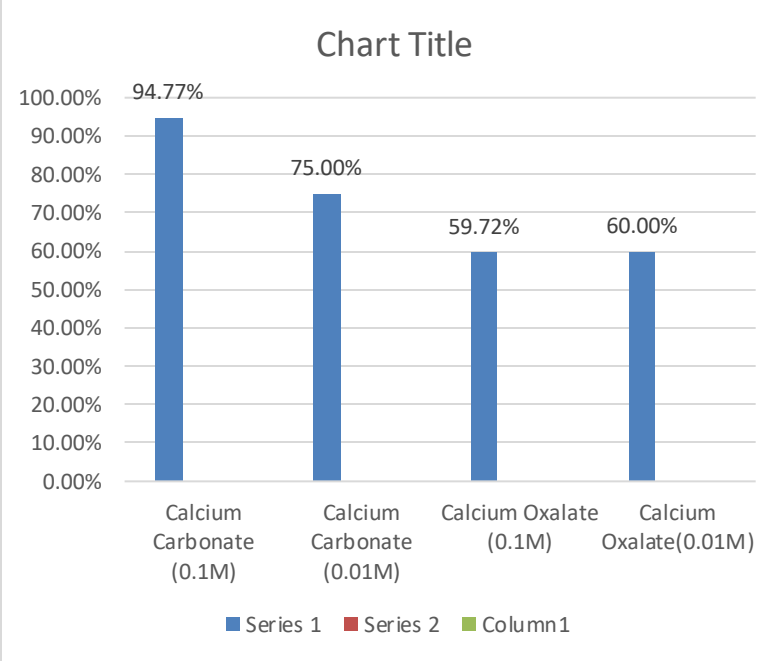
Graph 7:- 0.01M CaC_2O_4(SDM)



Graph 8:- 0.01M CaC_2O_4(RDM)



Graph 9:- Dissolution of urinary stone by Horse gram Extract



Results and Discussions:

Study of the Tables and Figs. suggests that *Tartaric acid, Glycine and horse gram are* moderate to good inhibitor of calcium oxalate and calcium carbonate mineralisation. Sequestering of this

insoluble calcium salts by acid might be due to effective single or mixed ligands chelation[5-6] by the hydroxyl acid present in them.

A comparative study of different model indicates that the r.s.m model is the most effective one in the inhibition of calcium oxalate and calcium carbonate mineralisation. This might be due to mass effect.[9-10] An abinitio presence of large concentration of inhibition (in the reservoir) coupled with continuous stirring might be effectively chelating the calcium ion and screening from precipitating anions like oxalate, carbonate and phosphate.

A comparative study also suggests that the inhibition efficiency decreases with a decrease in the strength of inhibitor solution. As the concentration of inhibitor decreases, the equilibrium might be favouring the precipitate of insoluble salts. lesser the inhibitor present less calcium ion be trapped as calcium-inhibitor complex and more calcium ions will be free for precipitate as insoluble salt. Our present study suggests that the regular intake of fruits containing hydroxyl and amino acids would be helpful in urinary stone prophylaxis.

The Comparative studies of these models indicates that the RDM (Reservoir Dynamic Model) is more effective one in the inhibition of mineralization. It might be due to the stirrer favoring in the chelating effect on Ca^{2+} ion with inhibitor and screening effect on precipitation reaction. The result also suggest that kurthi dal is very good inhibitor for mineralization of calcium ion dissolution. Our present finding with Kurthi (Dolichos bifluorus) suggest that it is a physiologically non-toxic natural product and a good solubiliser of calcium oxalate. It does so by virtue of its chain polyphosphate groups

References:

1 Kumar, A., Mahapatra (Choudhary), B., *Acta Ciencia Indica,***2011,** *37C(4),* 321.

2 Kumar, A., Mahapatra (Choudhary), B., *Bull. Pure Appl. Sci*.,**2011**, *30C(1-2)*, 31-38.

3 Curhan, C. C., Willett, W. C., Speizer, P. D. Stampfer, M. J., *Ann.Int. Med*., **1998**, *128*, 534.

4 Parman, M. S., *Brit. Med. J*., **2004**, *328*, 1420.

5 Das, I., Gupta, S. K., Pandey, V. N. and Shoeb, A. A., J. Cryst.Growth, **2004**, *267*, 654.

6 Smith, L. H., Meyer J. L. and McCall, J. T., *Int. Symp. Renal Stone Res., Karger, Basel*, **1973**, 318.

7 Stamatelou, K. K., Francis, M. E., Jones, C. A., Nyberg, L. M. Jr.,and Curhan, G. C., *Kidney Int.*, **2003**, *63*, 1817.

8 Seltzer, M. A. Low, R. K. Mc Donald, M., Shami, G.S. and Stolter,M. L., *J. Urol.*, 1996, 1156, 907.

9 Mayer, J. L. and Smith, L. H., *Invest. Urol.*, **1975**, *13*, 36.

10 Selvam, R., Kalaiselvi, P., Govindaraj, A., Murugan, V. B. and Sathish Kumar, A. S., *Pharmacol. Res*., **2001**, *43*, 89.

11 Munoz, J. A. and Valiente, M., *Urol. Res*., **2005**, *33(4),* 267.

12 Joshi, V. S., Parekh, B. B., Joshi, M. J. and Vaidya, A. B., *J. Cryst. Growth*, **2005**, *275*,1403

S.G.KABRA et. al. Indian J. Exptl. Biol. 14 (5), 569 (1976)