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# *In Vitro* Studies Attempting to Dissolve Urinary Calculi

*by*

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SUMMARY. 38 urinary calculi obtained at surgery were analysed and some of them were left in an indigenous preparation used by Siddha Ayurvedic Physicians, called "Nandukal pasmum." This preparation contains mainly calcium carbonate, which in water gives as alkaline solution of calcium hydroxide. Calculi containing mainly uric acid were found to disintegrate in a solution of Nandukal pasmum. The probable mechanism of action is that when uric acid and mono urates are the principal constituents of the calculi they form diurates which are more soluble in an alkaline solution. Hence the stones can dissolve, when sodium or potassium diurates are formed, or disintegrate into a powder, when calcium diurate is formed.

## INTRODUCTION

From time immemorial siddha ayurvedic practitioners have used various preparations for dissolving urinary calculi. One such preparation is known as "Nandukal pasmum".

In Tamil "nandu" means crab, "kal" means stone and "pasmum" means fine powder. The powder obtained from encrusted crab shells is made into a fine paste by grinding with water from *Cocos nucifera* (king coconut). The paste is then mixed with several ingredients including potassium nitrate and heated to a high temperature. The resulting powder is used in the treatment of urolithiasis. About 200 mg of the powder is administered in a tablespoonful of the juice of *Raphanus sativus* (radish) twice daily, for a varying period of time not exceeding one month. Radish juice is claimed to be a diuretic.

We are studying the *in vitro* effects, *in vivo* actions and toxic effects of this preperation. This is a report on the *in vitro* effect of a solution of "Nandukal pasmum" on 7 types of urinary calculi obtained fom patients.

## MATERIALS AND METHODS

The chemical composition of "Nandukal pasmum" was ascertained. An aqueous solution of the powder, of the same concentration as is used in the treatment of urolithiasis (800 mg/100 ml of water), was made and its pH determined.

A small portion of each of the urinary calculi was taken for analysis. Aliquots of each stone were left in a solution of "Nandukal pasmum" and in distilled water.

Aliquots were also kept in solutions of sodium bicarbonate (pH 8.6, 0.1M) calcium hydroxide (pH 9, 0.1 mM) and potassium citrate (pH 9.4, 0.5M) and ammonium chloride (pH 6.3, 0.6M) for the same number of days.

The wieght of the portion of stone before and after immersion in each solution was ascertained. When the stone appeared to have gone into solution or to have flocculated, the solution was filtered and the filtrate and precipitate analysed

## RESULTS

The composition of "Nandukal pasmum" is given in Table 1. The pH of its aqueous solution is 8.4. The calculi analysed were grouped according to their main composition as mainly urate, mainly oxalate, magnesium ammonium phosphate, calcium phosphate and mixed stones (unpublished data.) The loss of weight obtained when aliquots of the different types of calculi were left immersed in an aqueous solution of "Nandukal pasmum" for 30 days is shown in Table 2. The 100% urate calculus disintergrated completely, while others disintergrated to a varying extent, depending on their urate content. Distilled water had no effect, however. The chemical composition of the filtrate and flocculate obtained from calculi 1 and 2 (Table 2) is given in Table 3. The flocculate contained 100% urate.

TABLE 1. Composition of Nandukal pasmum

| | |
|---|---|
| $Ca^{2+}$ | 67.7g% |
| $Mg^{2+}$ | 1.169g% |
| $Hg^{2+}$ | 0.4 ppm |
| $K^{+}$ | 0.153g% |
| $PO_4^{3-}$ | 0.0985g% |
| $CO_3^{3-}$ | 17.40g% |
| $NO_3^{-}$ | 3.0 ppm |
| Urate | 0.048g% |

Table 4 shows the loss of weight of aliquots of the seven calculi when placed in different solutions for a period of 30 days. It will be noticed that there is a significant loss of weight in the urate stones in alkaline media with the exception of calculus No 5 and a negligible loss in the acid medium.

TABLE 2. **Loss of weight seen when different types of urinary calculi were left in Nandukal pasmum solution (pH 8.4) for 30 days.**

| Serial No. of calculi. | Composition | Site of calculus | Loss of weight g | Loss of weight g% |
|---|---|---|---|---|
| 1 | 100% Uric acid | Bladder | fully dis-intergrated. | 100 |
| 2 | 100% Uric acid | Bladder | - do - | 100 |
| 3 | 72% Urate/Uric acid | Bladder | 1.4904 | 30 |
| 4 | 29% Urate/Uric acid | Bladder | 0. 0420 | 8.5 |
| 5 | 31% Urate/Uric acid | Kidney | 0.0077 | 1.5 |
| 6 | Mainly oxalate | Kidney | 0.0900 | 0.4 |
| 7 | Mainly phosphate | Bladder | 0.0960 | 8.6 |

TABLE 3. **The composition of the filtrate and residue obtained after immersing calculi Nos. 1 & 2 (Table 2) for 10 days in an aqueous solution of Nandukal pasmum**

| Serial No. of calculi. | Weight of calculi | | Composition of | |
|---|---|---|---|---|
| | before g | after g | Filtrate Uric acid g% | Residue Uric acid g% |
| 1 | 1.2948 | Nil | 0.0200 | 106.33 |
| 2 | 5.7317 | Nil | 0.1800 | 103.99 |

TABLE 4. **Loss of weight of aliquots of calculi when immersed in different solutions for 30 days.**

| Serial No. of calculi | Solution | pH | Loss of weight g | Loss of weight g% |
|---|---|---|---|---|
| 1 | Calcium hydroxide | 9 | Fully dis-integrated | 100 |
| 3 | ,, | ,, | 2.0120 | 20.20 |
| 4 | ,, | ,, | 0.0567 | 11.19 |
| 5 | ,, | ,, | 0.1355 | 2.72 |
| 6 | ,, | ,, | 0.0019 | 0.06 |
| 7 | ,, | ,, | 0.0859 | 13.50 |
| 3 | Sodium bicarbonate | 8.6 | 1.0989 | 12.30 |
| 6 | ,, | ,, | 0.0735 | 1.40 |
| 3 | Potassium citrate | 9.4 | 0.4240 | 37.30 |
| 6 | ,, | 9.4 | 0.0257 | 2.10 |
| 3 | Ammonium chloride | 6.3 | 0.0503 | 7.10 |
| 6 | ,, | 6.3 | 0.0048 | 0.40 |

## DISCUSSION

Uric acid I (Fig. 1) in solution can exist in equilibrium with the enolised forms II & III, and the acidity of the uric acid is attributed to these forms. Uric acid generally forms monobasic and dibasic salts. The tribasic salts may be obtained at very high pHs. Uric acid, mono sodium urate, mono potassium urate and calcium urate are not very soluble in water whereas the disodium and dipotassium salts are relatively more soluble. Urate, if it is present in the urinary calculi, occurs as uric acid, mono alkaline metal urate or calcium urate or a mixture of these. If the calculus is composed of uric acid or mono alkaline metal urate, it may be possible to gradually leech these salts away with calcium hydroxide and other alkalis. In order to verify this, experiments were carried out to determine the effect of sodium bicarbonate and calcium hydroxide on the calculi. It was observed that some of the calculi were progressively broken down by sodium bicarbonate. These calculi must be composed of uric acid or the mono alkaline metal salt and the reaction taking place may be summarised as in Fig 2.

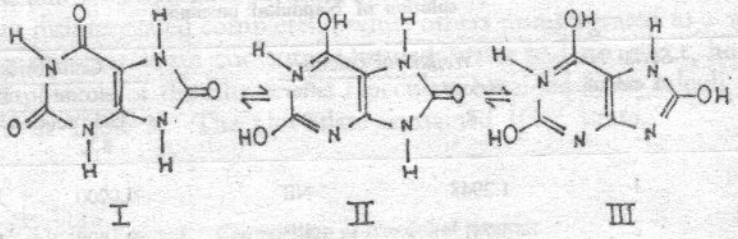


Fig. 1 Equilibrium between uric acid and its enolised form in aqueous solution.

Some of the calculi disintegrated into a powder form when treated with aqueous calcium hydroxide. This again may be attributed to the formation of dibasic calcium salt from the uric acid or mono alkaline metal urate in the calculus. Although calcium urate is insoluble in water, the reaction of calcium hydroxide with the calculus distrupts its crystalline (solid) form and weakens it, thereby disintegrating the solid (Fig 3).

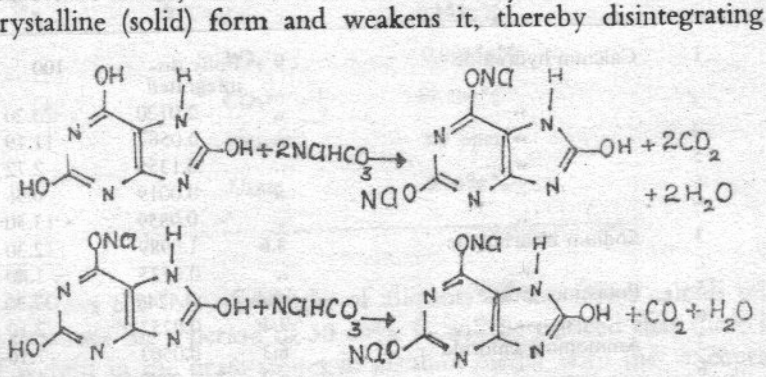


Fig. 2 Formation of sodium of salts of uric acid.

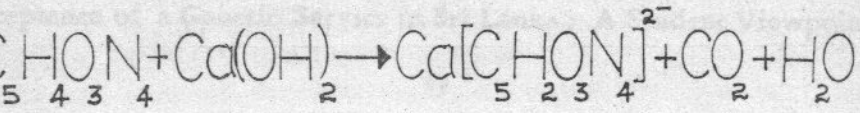

Fig. 3 Formation of calcium urate

Some of the mixed calculi containing uric acid/urate tested in this way did not dissolve in aqueous sodium bicarbonate. Therefore, it was thought that these calculi must be composed mainly of calcium urate. This inference was confirmed by the estimation of calcium in one of the calculi (No. 5), which showed that the calcium level is compatible with the presence of calcium urate in the stone.

"Nandukal pasmum" in solution can give calcium hydroxide and potassium hydroxide which are alkaline. The calcium and potassium could react with uric acid and mono urates, giving the dipotassium urates which are soluble and the calcium urate which is a powder. This was confirmed by analysis of the solution and precipitate obtained after leaving soluble stones (calculus 1 & 2) in "Nandukal pasmum" for some time (Table 3).

This study shows that the indigenous preparation "Nandukal pasmum" may have an effect on certain calculi, viz, those containing predominantly uric acid/urate. Therefore urate stones could be effectively treated with Nandukal pasmum.

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