

An Isotopic Method for Estimation of Urinary Potassium

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⁶⁰Cobalt labeled sodium cobaltinitrite can be used for the estimation of urinary potassium. The principle of the method is to precipitate the potassium present as the insoluble ⁶⁰Co labeled cobaltinitrite. The radioactivity of the precipitated potassium ⁶⁰cobaltinitrite is compared with a series of standard potassium solutions treated similarly and the concentrations determined graphically.

The estimation of urinary potassium by the cobaltinitrite precipitation method was first described over 30 years ago by Jacobs and Hoffman (1). However, in their method the potassium cobaltinitrite produced was determined by a colour reaction with sodium ferrocyanide and this was subject to errors due to the colouration of urinary pigments.

MATERIALS

All reagents used were "A.R. Grade," and all water was triple distilled and passed through an Amberlite-MB3 ion-exchange resin column before use.

Potassium standards: made with potassium chlorate in water to give final concentrations of 1, 10, 25, 50, 75, and 100 mEq/litre.

Sodium cobaltinitrite: The ⁶⁰cobalt was obtained from the Radiochemical Centre Amersham U.K. as cobalt chloride; it was converted to sodium cobaltinitrite by the following method.

23.8 gm of cobalt chloride and 100 μ c of ⁶⁰cobalt chloride were dissolved in 50 ml of water, to this was added 10.6 gm of anhydrous sodium carbonate in 50 ml of water.

The precipitated cobalt carbonate was purified by washing thrice with distilled water and separated by centrifuging, and then converted to cobalt nitrate by dissolving in 5N nitric acid. After filtration it was evaporated to dryness and stored in a dessicator.

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The working solution of ^{60}Co sodium cobaltinitrite (2) was made by dissolving 3.98 gm of the anhydrous cobalt nitrate in 30 ml water and mixing with 60 gm sodium nitrite in 30 ml of water. After shaking 15 ml of glacial acetic acid was added and the solution oxidised by bubbling air through for 30 min. The solution was made up to 250 ml with water. This reagent will keep for six to eight weeks at 4°C .

The 100 per cent ^{60}Co std: This was prepared by adding 5 ml saturated potassium ovalate solution to 5 ml sodium cobaltinitrite solution and the precipitate washed with water.

METHOD

All estimations were done in duplicate and with each batch of urine samples a series of potassium standards (1-100 mEq/litre) and a distilled water "blank" were processed.

Into each 6×1 inch hard glass test tube was added 1 ml of 40% aqueous sodium hydroxide solution (W/V) and 5 ml of the sample for estimation; then placed in a sand bath and heated so that the solution boiled for about 10 minutes to remove ammonium compounds.

After cooling, the contents of the test tubes were transferred to glass counting vials (capable of centrifuging), and the residue washed in with water. After bringing the samples to constant volume with water, 2 ml of glacial acetic acid

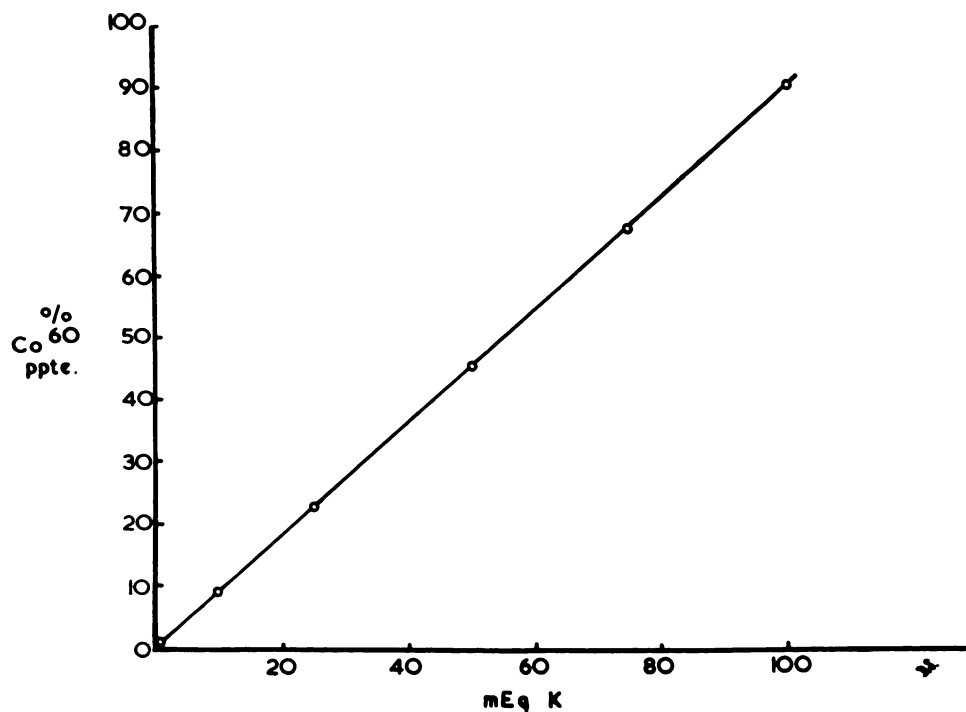


Fig. 1. The relationship of precipitated ^{60}Co to potassium concentration.

was added to prevent the excess sodium hydroxide precipitating the ^{60}Co as the hydroxide. Then 5 ml of the ^{60}Co labeled sodium cobaltinitrite solution was added and the mixture incubated at 38°C for 30 minutes to allow the potassium cobaltinitrite to precipitate.

The precipitate was separated by centrifuging at 3000 rpm for 5 minutes and washed twice with 10% aqueous acetic acid (V/V) and once with distilled water.

The radioactivity of the precipitate was assayed in a "well-type" scintillation counter.

RESULTS

TABLE I

COMPARISON OF RESULTS OBTAINED WITH FLAME PHOTOMETRY AND ^{60}Co Ppte METHODS ON 21 URINE SAMPLES.

<i>mEq/litre potassium (flame photometry)</i>	<i>mEq/litre potassium (^{60}Co ppte method)</i>
33	32.2
11	10.4
10	8.9
35	35.7
13	12.8
10	10.3
34	35.2
12	11.3
13	12.5
81	79.2
40	38.7
22	23.1
51	50.4
6	5.7
42	43.0
29	30.2
31	30.0
49	50.3
28	29.4
11	7.6
15	15.0

- From Table I it is obvious that good agreement between ^{60}Co ppte. method and flame photometry is obtained.
- Neither sodium or ammonium salts appear to effect the observed potassium levels.
- Finally, the results are easily reproducible, (variation of ∓ 1.3 per cent with six identical 30 mEq samples).

To calculate the per cent ^{60}Co in precipitate (ppte):

$$\% \text{ } ^{60}\text{Co in ppte} = \frac{\text{Mean cpm of duplicate samples} \times 100}{\text{cpm of 100\% } ^{60}\text{Co Std}} \times 1$$

(cpm-counts per minute after subtraction of the background count).

The conversion to absolute values of potassium was determined graphically from per cent ^{60}Co precipitated in known potassium standards (Fig. 1).

Twenty-one samples of urine (random samples from patients having exchangeable potassium studies) were compared with results obtained from flame-photometry studies (Table I).

The effect of varying concentrations of sodium (15-100 mEq/litre) and ammonium (5-25 mEq/ litre) salts was also observed.

To determine if results were reproducible six estimations on one 30 mEq/litre sample was done.

SUMMARY

An isotopic method for estimating urinary potassium has been described. It appears from our results that the method is accurate, sensitive and easily reproducible. Because the method is more time consuming than flame-photometry it would not be suitable for the routine bio-chemical laboratory. It would be suitable, however, for the research laboratory where a high degree of accuracy is required. The method can be suitably modified to estimate smaller or greater quantities than the present range, *i.e.* 1-100 mEq/ litre by adjustment of ratio of sodium cobaltinitrite to urine.

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