[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY, NEW YORK UNIVERSITY]

The Ternary Systems $NaNO_3$–$NaBr$–H_2O and $NaNO_3$–NaI–H_2O at 25°

BY JOHN E. RICCI, JOSEPH BUDISH AND NICHOLAS BORODULIA[1]

As part of the systematic phase rule investigation of ternary systems involving the alkali nitrates and halides, and for the purpose of obtaining solubility data, the ternary systems $NaNO_3$–$NaBr$–H_2O and $NaNO_3$–NaI–H_2O were studied at 25°. The results have shown the systems to be of the simple type at this temperature, with no complex formation, the only solid phases being the pure salts themselves, anhydrous or hydrated.

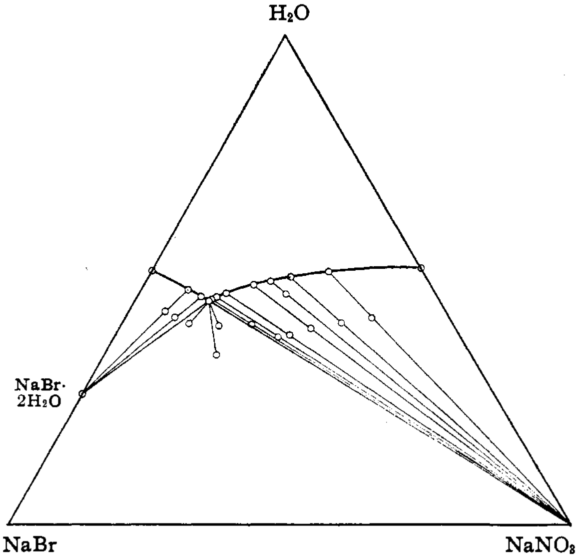

Fig. 1.—25° Isotherm: $NaNO_3$–$NaBr$–H_2O.

The experimental procedure was the familiar technique used in other similar investigations.[2] The salts used were recrystallized C. P. material. Weighed complexes of definite composition were brought to equilibrium by stirring in a thermostat at 25°, with the temperature constant to ±0.02°; the time allowed for equilibrium was at least two days in each case. The saturated solution was analyzed for bromide or iodide by titration with standard silver nitrate solution by means of Fajans' method, using fluorescein as the adsorption indicator, in the presence of some dextrin; this determination, combined with a determination of the total solids by proper evaporation, allowed the calculation of the sodium nitrate concentration by difference. Since no new solid phases were encountered, the phases of known composition were identified in every case by the algebraic extrapolation of the tie-lines joining the composition of the saturated solution and that of the original complex;[3] the error of these extrapolations then checks the accuracy of the analysis and the attainment of equilibrium. The average error, of extrapolation, in the $NaNO_3$–$NaBr$–H_2O system was 0.50%; in the $NaNO_3$–NaI–H_2O system, 0.38%.

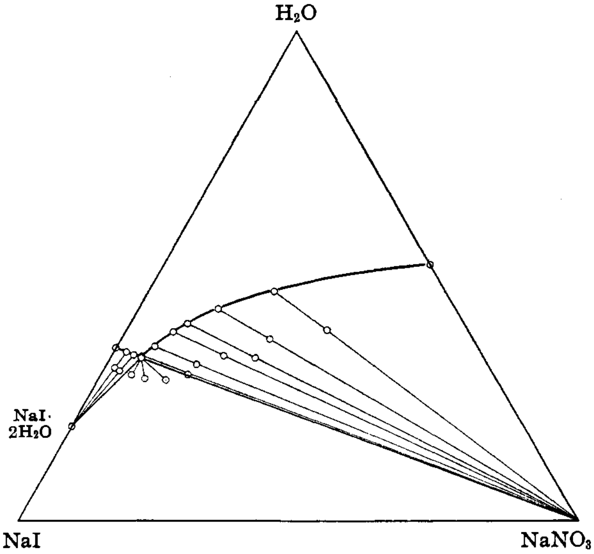

Fig. 2.—25° Isotherm: $NaNO_3$–NaI–H_2O.

TABLE I

SYSTEM $NaNO_3$–$NaBr$–H_2O AT 25°

Original complex, wt. %		Satd. solution, wt. %		Solid phase
$NaNO_3$	NaBr	$NaNO_3$	NaBr	
...	0.00	47.87	0.00	$NaNO_3$
43.97	13.98	31.67	17.02	$NaNO_3$
38.85	20.01	25.14	24.63	$NaNO_3$
33.96	26.00	19.80	31.54	$NaNO_3$
31.13	30.09	15.72	37.11	$NaNO_3$
28.96	33.02	14.42	39.74	$NaNO_3$
22.93	36.12	13.80	40.54	$NaNO_3$
17.68	42.10	13.64	41.03	$NaNO_3 + NaBr\cdot 2H_2O$
19.91	45.67	13.56	41.10	$NaNO_3 + NaBr\cdot 2H_2O$
11.98	46.97	13.67	41.02	$NaNO_3 + NaBr\cdot 2H_2O$
Average	(of 3)	13.62	41.05	$NaNO_3 + NaBr\cdot 2H_2O$
9.02	48.95	11.36	42.26	$NaBr\cdot 2H_2O$
6.54	50.43	8.41	44.08	$NaBr\cdot 2H_2O$
0.00	...	0.00	48.41	$NaBr\cdot 2H_2O$

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[1] Taken from work presented by Joseph Budish and Nicholas Borodulia for the Bachelor's Degree at New York University.

[2] Ricci, THIS JOURNAL, **56**, 290 (1934).

[3] Hill and Ricci, *ibid.*, **53**, 4305 (1931).

TABLE II

SYSTEM $NaNO_3$-NaI-H_2O AT 25°

Original complex, wt. %		Satd. solution, wt. %		Solid phase
$NaNO_3$	NaI	$NaNO_3$	NaI	
...	0.00	47.87	0.00	$NaNO_3$
35.90	25.27	22.57	30.49	$NaNO_3$
26.84	36.37	14.38	42.48	$NaNO_3$
26.07	40.95	10.64	49.22	$NaNO_3$
20.07	46.19	8.73	52.70	$NaNO_3$
16.01	52.02	6.77	57.64	$NaNO_3$
15.61	54.45	5.63	60.88	$NaNO_3$
9.96	60.88	5.47	61.11	$NaNO_3$ + $NaI{\cdot}2H_2O$
8.02	62.92	5.48	61.13	$NaNO_3$ + $NaI{\cdot}2H_2O$
5.43	64.73	5.50	61.14	$NaNO_3$ + $NaI{\cdot}2H_2O$
Average (of 3)		5.48	61.13	$NaNO_3$ + $NaI{\cdot}2H_2O$
2.97	66.35	3.93	62.06	$NaI{\cdot}2H_2O$
2.05	67.08	2.57	63.12	$NaI{\cdot}2H_2O$
0.00	...	0.00	64.71	$NaI{\cdot}2H_2O$

The experimental results are presented in Tables I and II, and are shown graphically also in Figs. 1 and 2, which are self-explanatory. The solubility isotherms are seen to be of the simple two-branched type, with no evidence of any complex formation. The compositions of the isothermally invariant solutions for the two systems, are, respectively, as follows: for saturation with respect to both $NaNO_3$ and $NaBr{\cdot}2H_2O$, 13.62% $NaNO_3$, 41.05% NaBr, 45.33% H_2O; for saturation with respect to $NaNO_3$ and $NaI{\cdot}2H_2O$ simultaneously, 5.48%$NaNO_3$, 61.13% NaI and 33,39% H_2O. These values are in each case the averages of at least three determinations.

Summary

Solubility measurements are given for the two ternary systems $NaNO_3$–NaBr–H_2O and $NaNO_3$–NaI–H_2O at 25°; no complex formation is found, the solid phases being $NaNO_3$ and, respectively, $NaBr{\cdot}2H_2O$ and $NaI{\cdot}2H_2O$.

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[CONTRIBUTION FROM THE BUREAU OF CHEMISTRY AND SOILS, U. S. DEPARTMENT OF AGRICULTURE]

Abundance Ratio of the Isotopes of Potassium in Animal Tissues

BY A. KEITH BREWER

The utilization of the mass spectrograph in determining the isotope abundance ratio and the atomic weight of potassium in minerals, plants and ocean water has been discussed in recent publications.[1–3] The results indicate that the isotope ratio is not necessarily constant in nature, but in specific instances may deviate appreciably from the normal. In the present paper this investigation has been extended to a study of the potassium isotope ratio in various animal tissues.

Experimental Technique

The apparatus was essentially the same as that described previously,[1] although several improvements were incorporated. The position of the filament slit was made adjustable by means of a screw operated through a sylphon tube; this permitted a better focusing of the maximum ion beam on the filament slit. The evacuation channel was extended completely along the bottom and both sides of the pole pieces; the channel not only facilitated evacuation but served as a trap to prevent ions not in focus from being reflected into the collector slit. The entire spectrograph was heavily chromium plated and the pole pieces highly burnished; it was found that when the iron pole pieces were exposed a deposit of rust collected on the surface which, because of its poor conductivity, became charged and in consequence distorted the resolved ion beam.

The samples of tissue to be tested were washed in distilled water and then ashed in a platinum crucible. The ion source used was a small platinum disk of the type described previously. The platinum was impregnated with potassium by placing a piece of ash about the size of a pin head on the disk and moistening with distilled water. The entire filament assembly was placed in a separate evacuation system and the filament heated to just redness for about thirty minutes; during the heating process an appreciable quantity of alkali dissolves in the platinum. After heating the disk was scraped free of all visible deposit; in cases where the ash fused on heating it was necessary to remove the disk from the filament to free it from ash. The disk was then smoothed by lightly tapping between plates and rewelded in position.

Results

The abundance ratios for the two principal isotopes of potassium found in various animal sources are presented in Table I.

In the abundance ratio column limits are expressed for the apparent uncertainty for each sample. The ratios given are the averages of determinations made on several samples while the uncertainty factor represents the limits to

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(1) A. Keith Brewer, THIS JOURNAL, **58**, 365 (1936).

(2) A. Keith Brewer, *ibid.*, **58**, 370 (1936).

(3) A. Keith Brewer, *J. Chem. Phys.*, **4**, 350 (1936).