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Table 1. Distribution of ^{90}Y between $CHCl_3$—DBP and 0.1 M HNO_3.

Conç. of DBP in $CHCl_3$ M	I_{aq} cpm	I_{org} cpm	log q	log K
0.003	1 471	13.1	—2.05	3.42
0.007	1 463	96.6	—1.18	3.19
0.01	1 162	276	—0.63	3.27
0.015	741	634	—0.07	3.31
0.02	457	900	+0.29	3.29
0.03	209	1 194	+0.76	3.23
0.05	47.3	1 493	+1.50	3.31
0.1	48.3	7 154	+2.17	3.07
			Mean value:	3.26±0.12

Separation of Strontium-90 and Yttrium-90 and the Preparation of Carrier-free Yttrium-90

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In investigations with the radioactive isotope ^{90}Sr it is often valuable to have a simple and rapid method of separating ^{90}Sr and its daughter ^{90}Y. Methods that have been used for this separation include ion exchange [1-3], precipitation [4-6], electrolysis [7], and solvent extraction [8-10]. As solvent extraction procedures usually are very efficient and rapid, it seemed worth while to develop such a method. Previously the TTA-benzene [8,9] and the DBP-dibutyl ether [10] systems have been used. As DBP (dibutyl phosphoric acid) extracts metal ions at lower pH values than TTA (thenoyl trifluoroacetone), we preferred to work out a procedure using DBP as a complexing agent.

The extraction with DBP and chloroform can also be used for the preparation of carrier-free ^{90}Y which is a suitable isotope for tracer experiments. A 0.1 M nitric acid solution of the long-lived parent ^{90}Sr will constitute a continuous supply of ^{90}Y.

Reagents. The fission product ^{90}Sr was obtained in 1 M HNO_3 from AERE, Harwell, England. ^{89}Sr was also purchased from Harwell as neutron-irradiated $SrCO_3$. The chloroform (analytical grade) was washed with water to remove the alcohol present. The di-*n*-butyl phosphate (DBP) was kindly supplied by Albright & Wilson Ltd, London. Titration with alkali and analysis of C and H. (Found: C 45.0; H 8.7. Calc. for $C_8H_{19}PO_4$: C 45.7; H 9.1) showed the compound to be at least 99 % pure.

General procedure. The experiments were carried out at 25°C. The aqueous phase (5 ml) with 0.1 to 10 M HNO_3 and ^{90}Sr was shaken 3 to 5 minutes with an equal volume of 0.003 to 1 M DBP in chloroform. After centrifugation 0.1—0.5 ml of each phase was withdrawn. The dried samples were then counted with a total absorber thickness of 200 mg/cm². Corrections were made for counting efficiency, background, and the *bremsstrahlung* from ^{90}Sr.

Table 2. Distribution of ^{90}Y between 0.1 M DBP in $CHCl_3$ and HNO_3.

Conc. of HNO_3 in the aqueous phase M	I_{aq} cpm	I_{org} cpm	log q	log K
0.1	48.3	7 154	+2.17	3.07
0.15	119	7 890	+1.82	3.25
0.2	180	7 634	+1.63	3.44
0.3	762	6 818	+0.95	3.28
0.5	2 310	5 120	+0.35	3.35
0.7	4 667	2 505	—0.27	3.17
1	6 544	1 134	—0.76	3.14
1.5	7 183	298	—1.38	3.05
2	6 952	180	—1.59	3.22
3	7 144	110	—1.81	(3.52)
5	7 292	53.4	—2.14	(3.86)
5	7 857	72.2	—2.04	(3.96)
7	7 630	20.4	—2.57	(3.87)
7	7 776	18.5	—2.62	(3.82)
10	7 132	89.2	—1.90	(5.00)
			Mean value:	3.22±0.13

Results. The results of the distribution experiments are given in Tables 1 and 2. It can be seen that ^{90}Y is more than 99 % extracted from 0.1 M HNO_3 with 0.1 M DBP in chloroform. Experiments with ^{89}Sr showed no activity in the organic phase under these conditions. However, with 1 M DBP small amounts of ^{89}Sr are extracted ($\log q = -2.216$). From this value we may calculate the extraction of ^{90}Sr to be less than 10^{-2} % ($\log q = -4.22$) with 0.1 M DBP.

Other measurements [11] have shown that DBP (HA) is highly dimerizised in chloroform. Within the concentration ranges of HNO_3 and DBP investigated here, the following equilibria may then explain the extraction of yttrium.

$$Y^{3+}\ (aq) + 3\ H_2A_2\ (org) \rightleftharpoons Y(HA_2)_3\ (org) + 3\ H^+\ (aq)$$

If the distribution of Y is given by

$$q = [Y(HA_2)_3]_{org}/[Y^{3+}]_{aq}$$

the equilibrium constant K will follow

$$\log K = \log q + 3 \log [H^+] - 3 \log C_A + 3 \log 2$$

where the DBP concentration in chloroform, $C_A = 2\ [H_2A_2]_{org}$.

The equilibrium constant K is calculated in the tables. The complex $Y(HA_2)_3$ is of a new type and will be further investigated. Other metal ions seem to form similar complexes [12].

Recommended procedure. a) Separation of ^{90}Sr and ^{90}Y. The sample is dissolved in 2—5 ml 0.1 M HNO_3 (HCl, $HClO_4$) and shaken with an equal volume of 0.1 M DBP in alcohol-free chloroform. The two phases are centrifuged and samples are withdrawn and evaporated to dryness. 80 % of the DBP in the chloroform sample may be removed at 190°C.

b) Preparation of carrier-free ^{90}Y. 5 ml of a 0.1 M HNO_3 solution with ^{90}Sr is shaken with 5 ml 0.1 M DBP in alcohol-free chloroform. The chloroform phase is then extracted with 5 ml of 5 M HNO_3. This nitric acid solution then contains 98 % of the ^{90}Y and 0.001 M of DBP. The DBP concentration can be lowered to 10^{-6} M, which is negligible for most purposes, by extraction first with 5 ml of chloroform and then twice with 5 ml of hexone (methyl *iso*butyl ketone). If carrier-free ^{90}Y is not wanted, inert yttrium may be added to the nitric acid solution and then precipitated with aqueous ammonia. This may be a convenient method of preparing an yttrium tracer, since neutron irradiated Y_2O_3 often contains some radioactive impurities.

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The Influence of Some Amino Acids on the Growth of and Vitamin B_{12} Production by *Streptomyces griseus* NzC5

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The purpose of this investigation was to study the influence of different amino acids on both the growth and the vitamin B_{12} formation of *Streptomyces griseus*.

Methods. The organism used for this investigation was a strain of *Streptomyces*