

ON THE SEPARATION OF MOLYBDENUM AND TECHNETIUM.
CROWN ETHER AS EXTRACTION AGENT

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Separation of ^{99}Mo and $^{99\text{m}}\text{Tc}$ can be performed with high selectivity using the crown ether 2,3,11,12-dibenzo-1,4,7,10,13,16-hexaoxacyclooctadeca-2,11-diene /DB18C6/ diluted with nitrobenzene. The high efficiency is attributed to the rather low extractability of molybdenum as compared with that of technetium.

INTRODUCTION

Due to its favourable nuclear characteristics, $^{99\text{m}}\text{Tc}$ is nowadays the most frequently used radionuclide in radiopharmacy. Its short physical half life of 6 h, the absence of corpuscular radiation, the emission of 0.14 keV γ -photons and the easy coupling of the central atom to versatile organ-specific ligands render possible the preparation of ready-to-use radiopharmaceuticals being excellent from the point of view of imaging technique and at the same time low body burden¹⁻⁴.

On the other hand, the short half life raises some difficulties in the supply of radiotechnetium to the clinical laboratories that can be overcome first of all by the delivery of molybdenum-technetium radionuclide generators.

The separation procedures applied are based on methods of chromatography, extraction or sublimation, all of which reveal advantages and disadvantages.

In case of extraction separation is usually performed with the aid of methyl ethyl ketone or methyl isobutyl ketone. In this paper a novel approach is outlined using dibenzene-18-crown-6 /DB18C6/ as an extracting agent.

EXPERIMENTAL

Batch experiments for determining distribution ratios of ^{99}Mo and $^{99\text{m}}\text{Tc}$ were separately performed in the same way as described before^{5,6}.

DB18C6 /Aldrich-Chemie GmbH/ dissolved in nitrobenzene was used as organic phase while carrier free $^{99\text{m}}\text{Tc}$ /reduced from pertechnetate by ascorbic acid/ and ^{99}Mo as sodium molybdate solution /specific activity 4 GBq g^{-1} Mo/, respectively, represented the aqueous phase.

Concentrations in both phases were determined of aliquots radiometrically, using a single channel pulse-height analyzer, type ACEC.

For technetium the photopeak at 0.14 MeV was measured while for molybdenum - being in transient radioactive equilibrium with technetium - the discriminator threshold was set well above the 0.14 MeV value in order to eliminate the pulses that were attributed otherwise to the daughter.

RESULTS AND DISCUSSION

Since our previous investigations on the extraction of technetium alone⁵ were focussed to determine the dependence of the distribution ratio on the pH and crown ether concentration, respectively, these were repeated in the same experimental range applying the technique outlined before, the only difference being that the concentration of the central atom /i.e., that of Mo/ was by about 7 orders of magnitude higher.

Albeit this fact excludes direct comparison, the real experimental conditions /being valid in generator systems/ are set in such a way.

The experimental results have unambiguously proved that the distribution ratio of molybdenum does not depend on the pH in the region $\text{pH} = 2.0-3.5$ and the crown ether concentration /0.002-0.10M/ either.

In addition, the ascorbic acid concentration set /0.1-1.0M/ showed practically no influence on distribution data, the average being $4.7 \times 10^{-3} \pm 0.3 \times 10^{-3}$.

Since the distribution ratio of technetium has a pronounced dependency on crown ether concentration⁵, the value of this has a decisive role in separation efficiency, first of all at higher concentrations of the extractant.

As shown in Fig. 1, the separation factor /defined as the quotient of the corresponding distribution ratios/ remarkably increases with concentration and therefore conditions can be attained, limited by solubility and economic considerations only.

Reextraction of technetium into the aqueous phase can be realized by acidification in the presence of mild oxidizing medium. However, the most promising trend

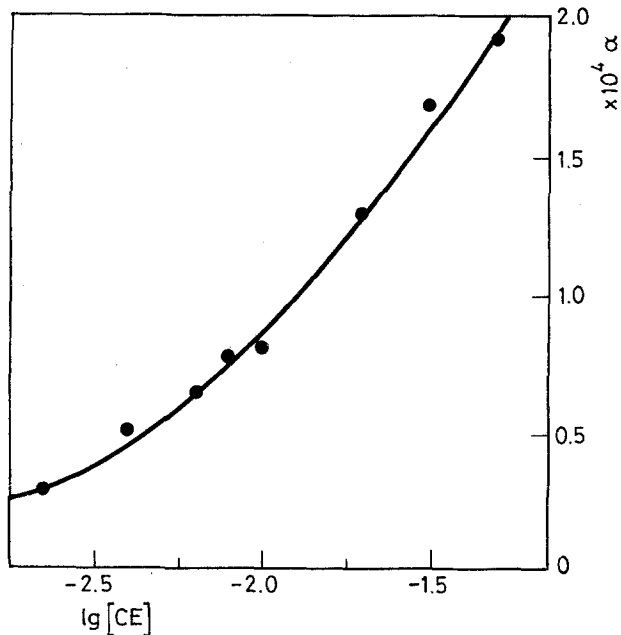


Fig. 1. Separation factor in the ^{99m}Tc - ^{99}Mo system as a function of crown ether /DB18C6/ concentration. Ascorbic acid concentration = 0.5M; pH = 2.05

in this field is to perform separation in one step by extraction chromatographic technique, as suggested for other systems already in 1970 /Ref. 7/.

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