Quality Analysis of (n, γ)^{99}Mo/^{99m}Tc Generator for labelling efficiency

Yong Bae Park, J. S. Lee*, K. H. Choi, S. S. Nam, U. J. Park, K. J. Son, B. S. Jang
Korea Atomic Energy Research Institute, Daedeuk-dero1045, Yuseong-Gu, Daejeon, Korea, 305-354
**Corresponding author: jlee15@kaeri.re.kr*

1. Introduction

Even though different types of generators have been developed to extract ^{99m}Tc [1], most of the generators uses ^{99}Mo from the fission products as the mother radionuclide of ^{99m}Tc. Recently, the crisis of ^{99}Mo production becomes one of the international issues as ^{99m}Tc is a dominant diagnostic radionuclide.

As an alternative to minimize such crisis, a new approach is proposed and studied. In this approach, the mother source of ^{99m}Tc comes not from fission products but from the neutron irradiation of molybdenum oxide.

Currently, the results from the research activities at Korea Atomic Energy Research Institute(KAERI) have shown such approach has enough potential as an alternative of the conventional generator.

KAERI received the production license for this generator from KFDA in 2011.

This article reports the performance of ^{99m}Tc extracted from the generator for the labelling yield with six cold kits. Also, the results of SPECT/CT imaging for a rat are reported.

2. Methods and Results

2.1 Labelling yield

To evaluate the labelling yield, ^{99m}Tc for this experiment is extracted from the (n,γ) ^{99}Mo/^{99m}Tc generator. Six different labelling compounds are employed for the test. Methylene diphosphonate (MDP), Dimercaptosuccinic acid (DMSA) and Macroaggregated albumin (MAA) are obtained from Mallincrodt medical Co., Ltd. Pyrophosphate and Diethylene triamine pentacetic acid (DTPA) are obtained from Fujifilm RI pharma Co., Ltd. Hexamethyl propylene amine oxim (HMPAO) was obtained from GE Healthcare Co., Ltd. The labelling procedure are provided in the Technical Reports series No. 466 Data.[4]

In general, 10mCi/3ml of $^{99m}TcO_4^-$ was added to each vial-kit upper mentioned vial-kit. After then the kits were mixed for one minute and to aged for five minute.

The labelling yield was measured by using ITLC(stationary phase : ITLC-SG, mobile phase : MEK or saline). Table 1 shows the results of the labelling yields for each compound. All of the labelling efficiencies with the selected compounds satisfy the requirements as the radiopharmaceuticals described in the pharmacopoeia.

All of labelled compounds are satisfactory as the criteria of ^{99m}Tc-radiopharma-ceuticals.

Labelled compound	USAGE	Labelling yield
^{99m}Tc-MDP	bone/articulation scan	≥98%
^{99m}Tc-DMSA	renal disease scan	≥99%
^{99m}Tc-MAA	lung disease scan	≥99%
^{99m}Tc-Pyrophosphate	heart/bone scintigraphy	≥92%
^{99m}Tc-DTPA	renal disease scan	≥99%
^{99m}Tc-HMPAO	brain disease scan	≥99% Lipophilic : Hydrophilic = 7:3 (Generally 8:2~7:3)

Table 1. Labelling yield of the compounds with ^{99m}Tc from (n,γ) ^{99}Mo/^{99m}Tc generator.

2.3 Animal SPECT-CT imaging

To evaluate the applicability of radio-imaging for the diagnosis purpose, SPECT/CT image with test of ^{99m}Tc-MDP was taken for a mouse.

The experiment was performed as follows :

^{99m}Tc-MDP in 2mCi/0.2ml quantity was injected to the ICR mouse. Then the bone SPECT images was taken after 1 and 3 hours of resting. Figure 1 show SPECT images of ICR mouse after injection of ^{99m}Tc-MDP. Figure 2 show Three dimensional SPECT/CT images of ICR mouse after 3hr of resting from the injection of ^{99m}Tc-MDP.

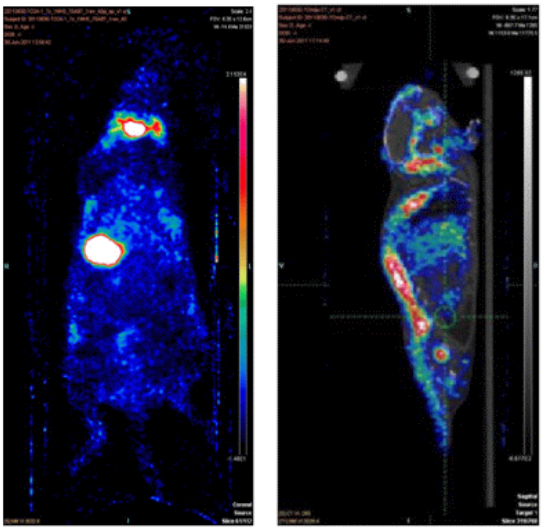

Fig 1. SPECT images of ICR mouse after 1hr(left) and 3hr(Right) resting from after injection of ^{99m}Tc-MDP

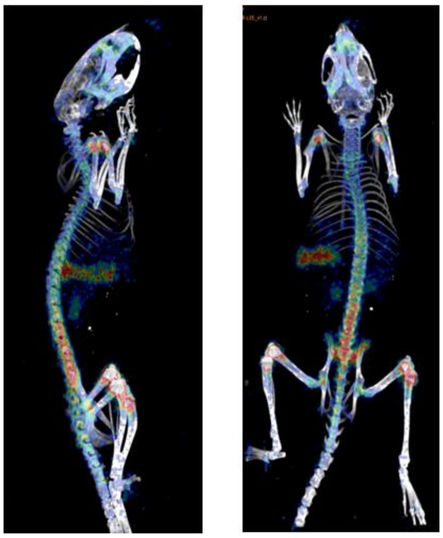

Fig 2. Three dimensional SPECT/CT images of ICR mouse 3hours after the injection of ^{99m}Tc-MDP

3. Conclusions

The labelling efficiencies with various labelling compounds and radio-imaging tests show that the quality of ^{99m}Tc from the developed (n, γ)$^{99}Mo/^{99m}Tc$ is adequate for the practical uses.

Labelling yield tests show good performance(92 ~ 99%) as required in the Korea pharmacopoeia. Also Animal SPECT-CT imaging test shows a clean and good performance. Hence, (n, γ)$^{99}Mo/^{99m}Tc$ generator has enough potential to be used in real applications.

REFERENCES

[1] F A. Mushtaq, Journal of Radioanalytical and Nuclear Chemistry, *262*, 797 – 810 (2004)..

[2] Jun S. Lee, et al. Progress on the Development of (n, γ)$^{99}Mo/^{99m}Tc$ generator, an Alternative of Conventional Generator, *Transactions of the Korean Nuclear Society Spring Meeting Pyeongchang, Korea,May*, 27 – 28, 2010

[3] Jun S. Lee, et al. Development of a High Performance 188W/188Re Generator by Using a Synthetic Alumina, Applied radiation and isotopes, *67*, 1162 – 1166, 2009

[4] IAEA, Technical Report series No. 466