REFERENCES

1. Fritzberg , A.R., Klingensmith III, W.C., Whitney, W.P., and Kuni, C.C. Chemical and Biological study of Tc-99m N,N'-Bis(mercaptoacetamido)-Ethelenediamine : A Pontential Replacement for I-13 Iodohippurate. J. Nucl. Med. 22(1981) : 258-263

2. Fritizberg, A.R., Klingensmith III, W.C., Whitney, W.P., and Kuni, C.C. Clinical Evaluation of Tc-99m N,N'-Bis(Mercaptoacetyl)-2,3 Diaminopropinoate as a Replacement for I-131 Hippurate : Concise Communication. ibid. 25(1984). 42-48.

3. Fritzberg, A.R., Kasina, S.,Eshima,D., and Johnson, D.L. Synthesis and Biological Evaluation of Technetium -99m MAG_3 as a Hippuran replacement. J. Nucl. Med. 07(1986) : 111-116.

4. Mallinckrodt Medical, Inc. "Techne Scan MAG3^{TM}" Kit for Preparation of Technetium Tc-99m Mertiatide Diagnostic - For Intravenous Use. St. Louis. 1990. (Mimeographed)

5. Harald, D., and Peter, H.C.Principles of Radiopharmacology. New York : Jena Fustav Fischer.Verl, 1987.

6. Arcia, R.G., Domenech, Mendez, O.A., Alvarez, J.G., and Marti, A.F.. Physico-Chemical Study of the Radio pharmarceutical ^{99m}Tc-DMSA, ^{99m}Tc-EDTA and ^{99m}Tc-DTPA Interaction with plasmatic Protiens. Int. J. Radiat. Appl. Instrum. Part A., 40(1989) : 536-538.

7. Huigen, Y.M., Tji, T.G., Glesema, W.J., and Ligny, C.L. A (Re)investigation of the Influence of some Metal Ion on the Mean Size of ^{99m}Tc(Sn)-MDP Constituents at Neutral pH. Int. J. Radiat. Appl. Instrum. Part A. 40(1989) : 431-432.

8. Gelsema, W.J., Ligny, C.L., and Tji, T.G.. The Influence of Sn(IV) on the Mean Size of ^{99m}Tc(Sn) MDP Constituents at Neutral pH. Int. J. Radiat. Appl. Instrum. Part A. 38(1987) :257-254

9. Gopal, B.S. and Charies, M.B. A Study of Protein-binding of ^{99m}Tc-Methylene Diphosphonate in Plasma. Int. J. Nucl. Med. Bio. 6(1979) : 201-206.

10. Harper, H.A., Rodwell, V.W., Mayes, P.A. Review of Physiological Chemistry. 16thed. PP.681-682. Los Altos, California: LANGE Medicine Publications, 1977.

11. Hay, F.W. Bio-Inorganic Chemistry. New York : Ellis Horwood Ltd, 1987.

12. Thomas, C.P., Carla, P.D., and et.al. Bioinorganic Activity of Technetium Radiopharmaceutical. J. Chem. Ed. 62(1985) : 965-973.

13. Trent, P., and Richard, W. Practical Nuclear Pharmacy. Hawaii : Bamyan Enterprises. Ltd., 1981.

14. Srivastava, S.C., and Richards, P., In Rayudu, G.V.S. and Colombetti, L.G.(eds.), Radiotracer for Medical Applications. Ch. 4. Boca Raton, FL : CRC Press, 1983.

15. Laurakhina, A.K., and Pozdnyakov, A.A., Analytical Chemistry of Technetium, Pronethium, Astatine, and Francium. Ch. 1. New York : Wiley & Son, 1965.

16. Deutsch, E., Libson, K., Juisson, S., and Lindoy, L.F., In Lippark, S.J. (ed.), Progress in Inorganic Chemistry. pp.75-139, New York: John Wiley & Sons, 1983.

17. Clarke, M.J.,and Fackler, P.H., In Clarke, M.J.(ed.), Topics in Inorganic and Physical Chemistry. pp.57-58, New York : Springer-Verlag, 1982.

18. Spencer, R.P., (ed.) Radiopharmaceutical : Structure-Activity Relationships. New York : Grune & Stratton, 1980.

19. Marzilli, L.G., Kramer, A.V., Burns, H.D., and Epps, L.A., In Deutsch, E., Nicolini, M., and Wagner, H.N.(eds), Technetium in Chemistry and Nuclear medicine. pp. 63-72 Verona : Cortian International, 1983.

20. Andreq, T.Jr., Dennis, E., Fritzberg, A.E., Paul, E.C., and Sudhaakar, K. Comparison of Iodine-131 OIH an Technetium 99m MAG_3 Renal Imaging in Volunteers. J. Nucl. Med. 27(1986) : 795-803.

21. Joseph, T.C., and Mark, S.R. Comparison of Technetium-99m MAG_3 kit with HPLC-Purified Technetium-99m MAG_3 and OIH in Rats.J. Nucl. Med. 28(1987) : 1881-1887.

22. Brandua, W., Bubeck, B., Eisanenhut, M., and Taylor, D.M. Technetium-99m Lebeled Renal Function and Imaging Agent : III. Synthesis of $Tc^{(99m)}$-MAG_3 and Bio-distribution of By-product. Int. J. Radiant. Appl. Instrum. Part A. 39(1988) : 121-129.

23. Cotton, F.A., and Wilkinson, G. Advanced Inorganic Chem istry A Conprehensive Text. 5^{th} ed. New York : John Wiley and Sons, 1987.

24. Bell, C.F. Principles and Application of Metal Chelation Ch. 2. Oxford : Oxford Univ. Press, 1877

25. Gans, P. SUPERQUAD DOCUMENT. Department of Inorganic and Structural Chemistry. Leeds : The University of Leeds,(1985). (typewritten)

26. Gans, P.,Sabatini, A., and Vacca, A.B. SUPERQUAD : An Improved General Programe for Computation of Formation Constants from Potentiometric Data. J. Chem. Soc. Dalton. Trans. (1985) : 1195-1200.

27. Hartley, F.R., Burgress, C., and Alcock, R.M. Solution Equiribria. New York : Ellis Horwood Ltd., 1980.

28. Irving, H.M., Miles, M.G., and Pettit, L.D. Anal. Chem. Acta, (1967) : 475

29. Hamilton, W.C., Statistics in Physical Science, pp.127 New York : The Ronald Press, 1964.

30. Burgess J., Metal Ions in Solution, pp. 397-399 Sussex : Ellis Horwood LTD, 1981.

31. Mallinckrodt Medical Inc., "System of Work for Tc-99m MAG_3", SBH 10/87, St. Louis (Mimeographed)

32. Hughes, H.N., The Inorganic Chemistry of Biological Processes, New York : Willey Inter Science, 1975.

33. Williams, D.R., The Metal of Life, Van Nostrand Reinhold, 1971.

34. Angelici, R.J., and Leslie, E.J., Inorganic Chemistry, 12 (1973) : 431.

35. Steffens, J.J., Sampson, E.J., Siewers, I.J., and Bonkovic, S.J., J.Amer. Chem. Soc., 95(1973): 936.

36. William, A.N., and James, N.N., Metal-Ligand Multiple Bonds. pp.52, New York : John Wiley & Son, 1988.

37. Morrison, R.T., Boyd, R.N., Organic Chemistry. 5thed., pp.966, Boston : Allyn and Bacon Inc, 1987.

APPENDIX

Appendix A

Physical Characteristic of ^{99m}Tc

Techntium-99m decays by isomeric transition with a physical half-life of 6.02 hours. The principal photon that is useful detection and imaging is listed in Table 1.

Table 1. Principal Radiation Emission Data

Radiation	Mean Percent Per Disintegration	Energy (keV)
Gamma-2	89.07	140.5

The specific gamma ray constant for technetium-99m is 0.78 R/mCi-hr at 1 cm. The first half-values for the relative attenuation of the radiation emitted by this radionuclide that results from interposition of various thicknesses of Pb is shown in Table 2. For example, the use of 0.25 cm of Pb will decrease the external radiation exposure by a factor of about 1000.

Table 1. Principal Radiation Emission Data

Shield Thickness(Pb) cm	Coefficient of Attenuation
0.017	0.5
0.08	10^{-1}
0.16	10^{-2}
0.25	10^{-3}
0.33	10^{-4}

To correct for physical decay of this radionuclide, the fractions that remain at selected time intervals after the time of calibration are shown in Table 3.

Table 3. Physical Decay Chart : Technetium Tc 99m, Half-life 6.02 Hours

Hours	Fraction Remaining	Hours	Fraction
0	1.000	7	0.477
1	0.891	8	0.398
2	0.794	9	0.355
3	0.708	10	0.316
4	0.631	11	0.282
5	0.562	12	0.251
6	0.501		

Appendix B

Radiation Dosimetry

The estimated radiation doses to the average adult (70 kg) from an intravenous administration of 185 MBq (5 mCi) and 370 MBq (10 mCi) technetium Tc-99m MAG_3 are presented in Table 4. These radiation absorbed dose values were calculated using the Medical Internal Radiation Dose Committee (MIRD) Scheme.

Table 4.

ESTIMATED ABSORBED RADIATION DOSES* Technetium Tc-99m MAG_3				
Organ	mGy/ 185 MBq	(rads/ 5 mCi)	mGy/ 370 MBq	(rads/ 10 mCi)
Urinary Bladder Wall	24	2.4	48	4.8
Upper Large Intestine Wall	0.94	0.094	1.9	0.19
Gall bladder Wall	0.81	0.081	1.6	0.16
Lower Large Intestine Wall	1.6	0.16	3.3	0.33
Kidneys	0.72	0.072	1.4	0.14
Small Intestine	0.81	0.081	1.6	0.16
Ovaries	1.3	0.13	2.6	0.26
Liver	0.18	0.018	0.48	0.036
Red Marrow	0.24	0.024	1.4	0.048
Testes	0.81	0.081	1.6	0.16
Total body	0.33	0.033	0.67	0.067
* Assuming patient voids at 4.8 hour intervals				

VITA

Mr. Khajadpai Thipyapong was born on April 13, 1964 in Bangkok Thailand. He recieved his Bachelor's Degree of Science in Chemistry from Srinakharinwirot University Bangsaen in 1985. After graduated, he has worked as a Nuclear Scientist at Office of Atomic Energy for Peace for 2 years. Since 1988 he has been a graduate student of Chemistry department, Chulalongkorn University