IMAGING SCANNER USAGE IN RADIOCHEMICAL PURITY TEST

PENGGUNAAN IMAGING SCANNER DALAM UJIAN KETULINAN RADIOKIMIA

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Abstract

Imaging Scanner model BIOSCAN AR-2000 has been used in the radiochemical purity test for the product of Mo99/Tc99m generator. Result from this test was produced directly where the percentage of pertechnetate was calculated based on width peak area by thin layer chromatography. This paperwork will explain the function, procedure, calibration of the instrument and discussed the advantages compared to the previous method.

Abstrak

Alat Imaging Scanner model BIOSCAN AR-2000 digunakan dalam ujian ketulinan radiokimia produk penjana Mo99/Tc99m. Keputusan ujian diperolehi secara terus dimana peratus bahan perteknetate dihitung berdasarkan keluasan kawasan puncak yang terhasil pada kromatografi lapisan nipis. Kertas kerja ini akan menjelaskan tentang fungsi, cara penggunaan dan penyenggaraan alat tersebut serta membincangkan kelebihannya berbanding dengan kaedah yang diguna sebelum ini

Keywords: radiochemical, scanner.

INTRODUCTION

Medical Technology Division (BTP) is the only one manufacturer of Technetium (Tc-99m) generator in our country. Every week the generators were delivered to local hospitals for use in nuclear medicine. Its application is mostly for diagnostic purposes as Tc-99m is labeled with radiopharmaceutical kit before it is injected into patient for scanning of target organ. Radiochemical purity test is one of the tests that required in Quality Control (QC) procedure to ensure the purity of Tc 99m pertechnetate presence in the sample should be more than 95%. The specification that we use is based on the standard in US Pharmacopoeia (USP).

Radiochemical purity can be defined as the proportion of the total radioactivity in the sample which is present as the desired radiolabelled species. Radiochemical purity is important in radiopharmacy since it is the radiochemical form which determines the biodistribution of the radiopharmaceutical. Radiochemical impurities will have different patterns of biodistribution which may obscure the diagnostic image obtained and render the investigation meaningless.

The most commonly used method to test the radiochemical purity in sample is by using chromatography method, which separates the different species on the basis of their differing affinities for a variety of liquid or solid phases. Therefore, Bioscan AR-2000 Imaging Scanner provides the latest technology in radioisotope scanning for thin layer chromatography (TLC) plates and certain types of blots and gels. This imaging scanner is a useful instrument for the direct analysis and quantitation of radiochemical purity as assayed by the thin layer chromatography (TLC). The imaging scanner provides rapid quantitation of these analyses with a minimum of sample handling, thus minimizing technician exposure and bench time.

The Bioscan AR-2000 Imaging Scanner provides direct digital counting of all the isotope. Combined with WinScan software, it is a complete radio TLC chromatography system. The result will produce a plot of activity versus peak positions accurate to within 1 mm of the actual peak position on the sample plate.

2. MATERIALS AND METHOD

2.1 Instrumentation.

Figure 1: The Bioscan AR 2000 Imaging Scanner

The imaging scanner system consists of Bioscan AR-2000 scanner, and connection to PC running the WinScan software. The system includes the software for instrument control, data analysis, and report generation. Result can be presented as chromatograms and quantitation of peaks is automatically performed, and the report showing the method used, chromatogram and percent of total activity for each peak provided

The scanner requires a P-10 gas source at a range of 20 psi to 25 psi. The P-10 gas is composed of 90% Argon and 10% methane. The imaging scanner uses a gas-filled proportional counter, which can detect all beta and gamma emitting isotopes. This detector image an entire TLC lane at one time thus minimizing overall analysis time. Less than a minute is usually sufficient to analyze a single automated run without operator intervention.

The data reduction system is based on a Windows based computer so that the chromatograms and quantitation can be displayed on the screen, print out, and stored on disk for record keeping and review as needed. The program identifies peaks and automatically provides Rf and percentage of the total activity for each peak. Raw data and computation can also exported in ASCII files for use with other software.

2.2 Preparation of Sample.

The ITLC paper was cut into size of 6.7mm x 0.85mm strip.

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Then, the ITLC strips were heated in oven at 100 degree Celsius for at least 15 minute prior to use.

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A fine drop the Tc-99m sample was applied on the strips at the origin line.

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The strips were dipped in the acetone mobile phase. The mobile phase will carried up the sample from the origin line to the solvent front.

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As the sample reach the solvent front, take them out from the mobile phase and dry under heat.

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The dried strips was placed inside the plastic pocket attached to the sample plate.

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Now the sample is ready for measurement by using the Bioscan AR 2000 scanner.

2.3 Calibration Procedure.

Before the sample measurement is carried out, the scanner must pass the Resolution and Efficiency calibration procedure.

2.3.1 Resolution Calibration

The Bioscan calibration plate is place on the scanner and the position tab aligned to the resolution line on the calibration plate. Then, press the Detector Lift button at the scanner and wait until the detector arm lift up and stop at the position. The detector cover will be replaced with the high resolution collimator at the bottom of the detector arm. During the calibration process, the HV red indicator light was on, the Count Rate indicator was blinking and the P-10 gas bubble lift up between 2.0 -2.5 liter per minute. After finish the process, the data will be reported with both graphic and summary report of the peak areas. The resolution should be greater than 85%.

Figure 2 below show chromatogram of resolution calibration and the reading of both resolution peaks are 96.57mm and 105.42mm respectively.

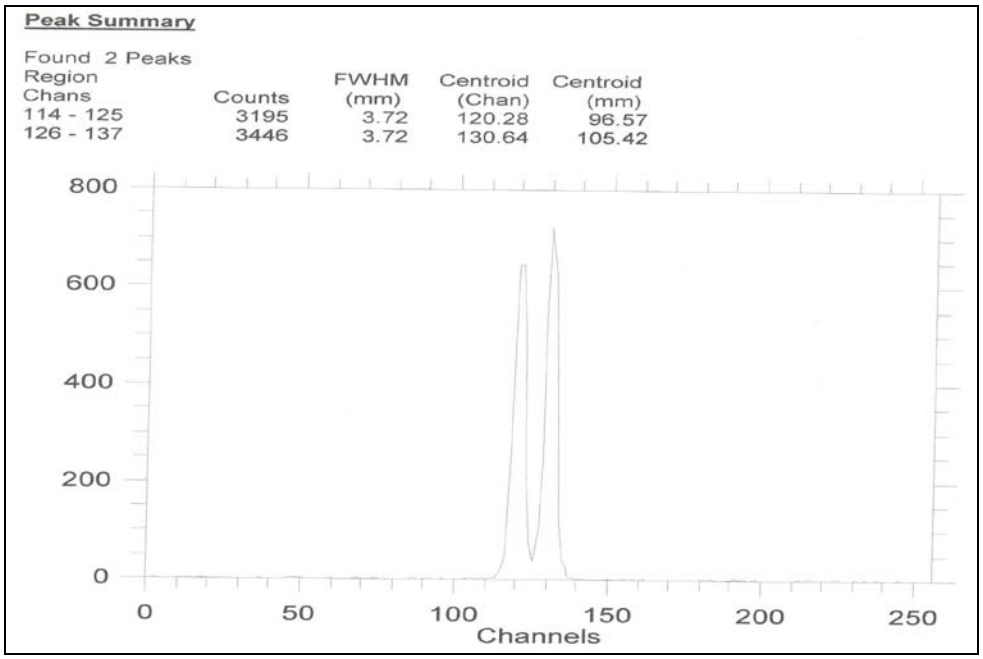

Figure 2: Chromatogram of Resolution Calibration

2.3.2 Efficiency Calibration

The high efficiency collimator is place at the bottom of the detector arm to replace the high resolution collimator. The detector arm then moves and stops at the efficiency tab and the calibration process running for 120 seconds. During the calibration process, the HV red indicator light was on, the Count Rate indicator was blinking and the P-10 gas bubble lift up between 2.0 -2.5 liter per minute. After finish the process, the data will be reported with both graphic and summary report of the peak areas. The value should be within 3 mm of the expected plate values.

Figure 3 below is chromatogram of efficiency calibration that show three peaks with reading 0.13 mm ,0.25 mm, and 0.12 mm respectively.

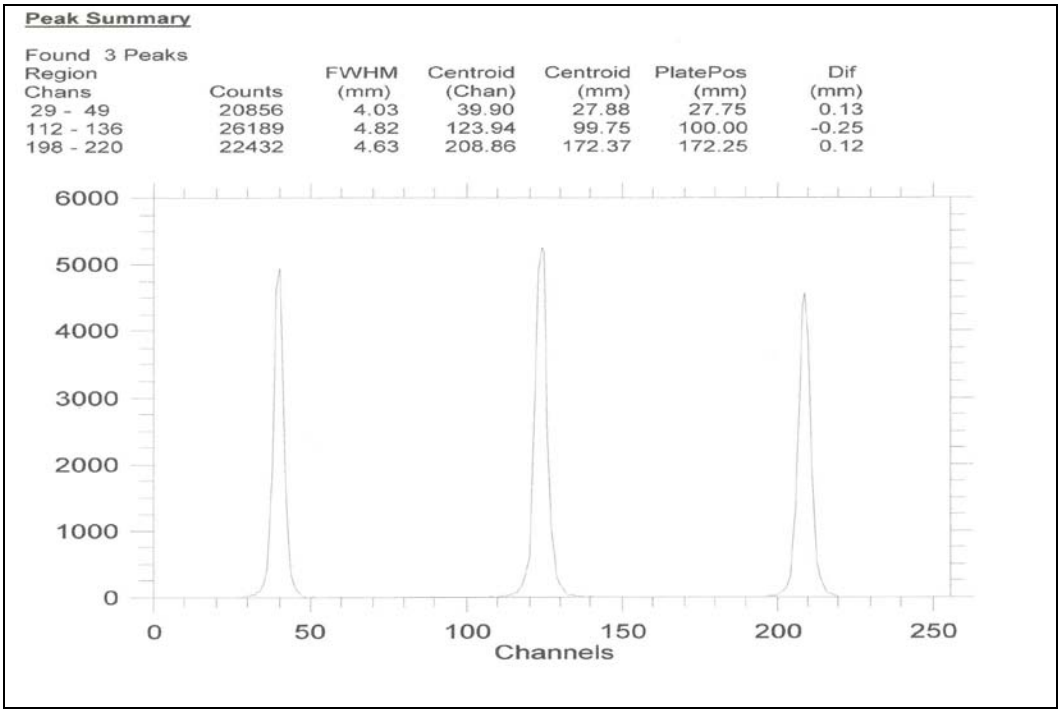

Figure 3: Chromatogram of Efficiency Calibration.

2.4 Measurement of Sample.

Place the dries ITLC strips inside the plastic pocket attached to the sample plate. Place the sample plate on the scanner and position each tabs at the middle of each strips available on the sample plate. Press the Detector Lift button at the scanner and wait until the detector arm is lifted up and stop at position then place the high efficiency collimator under the detector arm.

Click the WinScan V3 icon on the desktop display. Key in the information required such as the method chosen and the batch number. The strips place on the sample plate from left to right position according to the generator number. The detector arm will then move to the first sample tab and scanning for 30 seconds. During the scanning process, the HV red indicator light was on, the Count Rate indicator was blinking and the P-10 gas bubble lifted up between 2.0 -2.5 liter per minute. The detector arm will then move to the next sample tab, and the sample scanned until the end.

The WinScan V3 software automatically provides Rf and percentage of the total activity for each peak. The percentage of the radioactivity accumulation at solvent front region should be more than 95%. After scanning is done, individually lane report will be automatically printed. Switch off the computer system, the scanner main unit and close the P-10 gas after finish scanning all the sample.

3.0 RESULT AND DISCUSSIONS

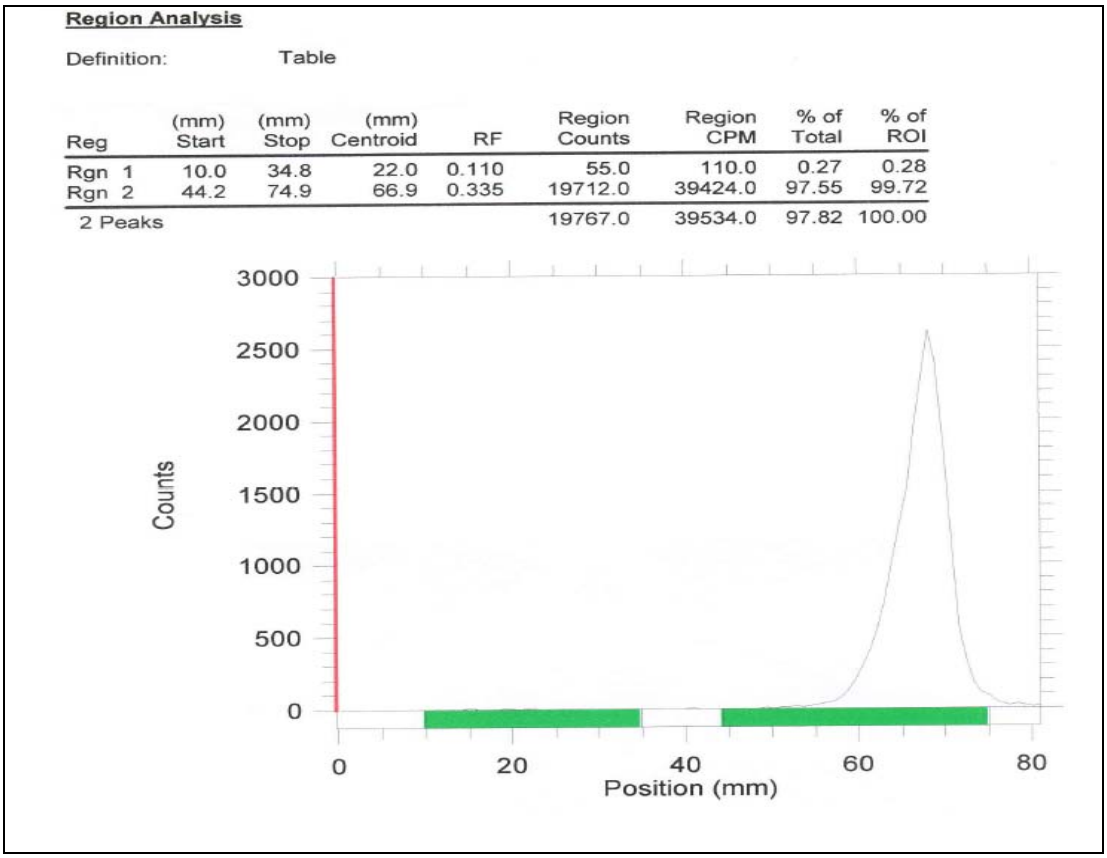

Figure 4: Chromatogram of radiochemical purity Tc 99m.

Chromatogram above is sample result for radiochemical purity of Tc99m generator. The result provides us the Rf value and the percentage of the region of interest (ROI) directly. From the chromatogram it show two region of interest which is at position 10 mm to 35 mm and the other one at position 45mm to 70mm. the first region is equivalent to the measurement taken from the origin of the strips, whilst the second region is measurement taken from the solvent front part which the sample of Tc 99m that carried up by the mobile phase accumulate there. From the result, the percentage of ROI for second region is 99.72% which indicate the purity of the Tc 99 pertechnetate presence in the sample is 99.72%

3. 1 Bioscan AR2000 Scanner versus Gamma Counter.

Counting radiochemical purity of the Tc 99m sample can be done either by using AR2000 scanner or gamma counter as previous method used. Both instruments need the same sample preparation but the different is in counting of ITLC strip. For method using gamma counter, ITLC strip need to be cut into half to divide the strip into two regions and both strips were counted for radioactivity of Tc 99m using gamma counter. It takes about several minute to complete the counting process for a single strip. Whilst, the AR2000 scanner count radioactivity without cutting the strip into half. It takes about only 30 seconds to complete the counting process.

AR2000 scanner is an analytical instrument that capable to produce accurate quantitation of minor compound down to less than 0.1% of the total chromatogram activity. It provides rapid quntitation and direct digital counting of the isotope. The data will reported with chromatogram and report of peak area. Whilst, the gamma counter do not produce the result directly as the raw counting data need for further calculation to obtain the result.

With this latest technology in radioisotope scanning provide by AR2000 scanner, it has minimum of sample handling, thus minimizing the radiation exposure. Therefore, using the AR2000 scanner can minimize working time and reduce the usage of ITLC paper rather than the previous method.

CONCLUSION

Bioscan AR-2000 Imaging Scanner provides the latest technology in radioisotope scanning for thin layer chromatography (TLC) plates. It is a useful instrument for the direct analysis and quantitation of radiochemical purity Tc 99m. The imaging scanner provides rapid quantitation of these analyses with a minimum of sample handling, minimizing radiation exposure and working time as compared to the previous method that using the gamma counter to count the activity.

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