ABSTRAK

Boron Neutron Capture Therapy (BNCT) merupakan metode terapi kanker yang menggunakan reaksi nuklir antara Boron-10 dengan neutron untuk menghancurkan sel kanker. Penelitian dilakukan dalam skala mikrodosimetri untuk mengevaluasi efek radiasi pada tingkat sel. Penelitian mengenai pemodelan dan perhitungan mikrodosimetri BNCT ini bertujuan untuk memodelkan sel kanker dalam bentuk *single* dan *multi cell,* menentukan jangkauan partikel α dan ^{7}Li dan nilai *Linear Energy Transfer* (LET), serta menentukan distribusi dosis partikel α dan ^{7}Li. Penelitian dilakukan menggunakan senyawa *Boronophenylalanine* (BPA) dan *Sodium Borocaptate* (BSH) secara simultan dengan tahapan meliputi tahap persiapan, pemodelan *single* dan *multi cell*, penyusunan listing program dan simulasi menggunakan program *Particle Heavy lon Transport System* (PHITS), serta analisis data. Hasil penelitian berupa model sel kanker *single* dan *multi cell* berbentuk bola dalam bentuk 2D dan 3D, jangkauan partikel α sebesar 10 μm dan partikel ^{7}Li sebesar 4 μm, nilai LET partikel α sebesar $251{,}19\ \mathrm{KeV/\mu m}$ dan partikel ^{7}Li sebesar $363{,}08\ \mathrm{KeV/\mu m}$. Distribusi dosis partikel α dan ^{7}Li model *single cell* pada inti sel sebesar 3,9275 Gy, sitoplasma A sebesar 4,1257 Gy, sitoplasma B sebesar 4,1514 Gy, dan membran sel sebesar 2,39303 Gy. Dosis rata-rata pada model *single cell* sebesar 3,29 Gy. Sedangkan distribusi dosis model *multi cell* diperoleh diperoleh dosis pada bagian inti sel sebesar 3,1893 Gy, sitoplasma A sebesar 4,964 Gy, sitoplasma B sebesar 5,3359 Gy, dan membran sel sebesar 2,85581 Gy. Dosis rata-rata pada model *multi cell* sebesar 4,087 Gy. Hal tersebut menunjukkan penggunaan senyawa BPA dan BSH secara simultan lebih efektif dibandingkan dengan penggunaan senyawa BPA dan BSH secara terpisah untuk terapi BNCT.

Kata Kunci: BNCT, mikrodosimetri, BPA, dan BSH.

ABSTRACT

Boron Neutron Capture Therapy (BNCT) is a cancer therapy method that uses nuclear reactions between Boron-10 and neutrons to destroy cancer cells. The study was conducted on a microdosimetric scale to emit radiation effects at the cellular level. The study on modeling and calculating BNCT microdosimetry aims to model cancer cells in single and multi-cell forms, determine the range of α and ^{7}Li particles and Linear Energy Transfer (LET) values, and determine the dose distribution of α and ^{7}Li particles. The research was conducted using Boronophenylalanine (BPA) and Sodium Borocaptate (BSH) compounds simultaneously with stages including the preparation stage, single and multi-cell modeling, compilation of listing programs and simulations using the Particle Heavy Ion Transport System (PHITS) program, and data analysis. The results of the study were single and multi-cell cancer cell models in the form of balls in 2D and 3D, the range of α particles was 10 μm and ^{7}Li particles was 4 μm, the LET value of α particles was 251.19 KeV/μm and ^{7}Li particles was 363.08 KeV/μm. The dose distribution of α and ^{7}Li particles in the single cell model in the cell nucleus was 3.9275 Gy, cytoplasm A was 4.1257 Gy, cytoplasm B was 4.1514 Gy, and the cell membrane was 2.39303 Gy. The average dose in the single cell model was 3.29 Gy. While the dose distribution of the multi-cell model obtained a dose in the cell nucleus of 3.1893 Gy, cytoplasm A was 4.964 Gy, cytoplasm B was 5.3359 Gy, and the cell membrane was 2.85581 Gy. The average dose in the multi-cell model was 4,087 Gy. This shows that the use of BPA and BSH compounds simultaneously is more effective than the use of BPA and BSH compounds separately for BNCT therapy.

Keywords*: BNCT, microdosimetry, BPA, and BSH.*