EFFECT OF DIFFERENT THERMAL NEUTRON FLUXES ON BLOOD OF MALE MICE

A.A. Abd El-Latif [a], Khalifa S. Saeid[b], and Namat ,M. Emara[c §]

a Physics Department, Faculty of Education in Al Areish, Sues Canal University, Egypt
b Physics Department, Faculty of Science, Omar El-Mukhtar University, El-Beida, Libya
C Biology Department, Faculty of Science, Tanta University, Egypt
**Address now: Physics Department, Faculty of Science, Omar El-Muhktar University, El-Beida, Libya*
§ Address now: Physiology Department, Faculty of Medicine, Omar El-Muhktar University, El-Beida, Libya

This work deals with the exposing of male mice to different fluxes of thermal neutron .Investigation has been performed by calculating of thermal neutron fluxes($0.27x10^8$ N/cm^2.1h, $0.54x10^8$ N/cm^2.1h, $1.08x10^8$ N/cm^2.1h, $2.16x10^8$ N/cm^2.3h and 4.32x108 N/cm^2.6h) which emitted from neutron irradiation cell with source Ra – Be (α,n) have activity 3 mCi made by leybold (55930) . The number and differential leucocytes counts types of white blood cells in million per cubic millimeter (W. B. Cs. mm^{-3}) ,the number of platelets mm^{-3},the number of red blood cells in million per cubic millimeter (R. B. Cs. mm^{-3}), the hemoglobin in Blood (mg/dl),the lymphocytes, and the eosiniphil leucocytes in blood decrease with increasing thermal neutron fluxes. But neutrophile and monocytes in blood increase with increasing the thermal neutron fluxes.
Keywords: *Thermal neutrons fluxes, male mice, blood*

INTRODUCTION:

Radiation is considered as one of the most dangerous sources of pollution that causes mutagenic and carcinogenic disorders in human , animals , and plants[(1)]

The sequence of events following interaction of radiation with biological matter are: Physical Stage, Physicochemical Stage, Chemical Stage and Biological Stage

The Physical Stage

The duration of the physical stage is about 10^{-13} s where there are two effects or modes of action that are distinguished

(I) Direct action involves absorption of energy by ionization and excitation (or nuclear displacement or transmutation) in the biological molecules where the lesion eventually appears.

(II) Indirect action refers to absorption of energy in a different molecule,(e. g. water) , resulting in diffusible free radicals and other reactive species that can migrate to and damage the bio molecule.

The Physicochemical Stage

The physicochemical stage lasts about 10^{-11} s, an ionized or displaced atom may produce a primary lesion , such as a break in the molecule, either directly or following intermolecular energy transfer.

The indirect action in water results first in ionization of water molecules

$$H_2O \rightarrow H_2O^+ + e^- \quad (1)$$

The positive ion forms a hydroxyl radical by

$$H_2O^+ \rightarrow H^+ + OH^0 \quad (2)$$

A hydrogen radical (atom)is formed by

$$H_2O + e^- \rightarrow OH^- + H^0 \quad (3)$$

Hydrogen and hydroxyl radicals can also be formed by dissociation of the water molecule following excitation,

$$H_2O \rightarrow H_2O^{\ddagger} \rightarrow H^0 + OH^0 \quad (4)$$

The free electrons polarize water molecules in the vicinity, forming the relatively long – lived hydrated electron ($_{ac}e^-$). The $_{ac}e^-$, H^0 , and OH^0 radicals may diffuse to, and react with the bio molecule and damage it .In living cells the damage from the direct and indirect actions are about equal for low – LET radiation (electrons, γ-rays) . In dry systems indirect action can still occur by formation of atomic hydrogen from organic molecules,

$$MH \rightarrow M^0 + H^0 \quad (5)$$

At high - LET (ions, neutrons), it is usually direct action that is predominant.

The Chemical Stage

The chemical stage lasts about 10^{-8} s at normal temperatures. In tracks from high – LET particles, the density of radicals is large and recombination occurs , giving non reactive or less reactive products

$$H^0 + OH^0 \rightarrow H_2O \quad (6)$$
$$H^0 + H^0 \rightarrow H_2 \quad (7)$$
$$OH^0 + OH^0 \rightarrow H_2O_2 \quad (8)$$

The net yields of H_2 and H_2O_2 (hydrogen peroxide) are small in pure water because of back reactions with $OH^0$and H^0. However, if molecular 0xygen is present, the H^0 combines to form the relatively long – lived peroxyl radical.

$$H^0 + O_2 \rightarrow (HO_2)^0 \quad (9)$$

Peroxyl radical in turn form hydrogen peroxide

$$(HO_2)^0 + (HO_2)^0 \rightarrow H_2O_2 + O_2 \quad (10)$$

If a reducing agent (electron donor) is present as well , more hydrogen peroxide is formed by

$$(HO_2)^0 + e^- \rightarrow (HO_2)^- \quad (11)$$
$$(HO_2)^- + H^+ \rightarrow H_2O_2 \quad (12)$$

The radicals and hydrogen peroxide can reduce or oxidize biological molecules. Typical reactions are

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$$MH + H^0 \rightarrow (MH_2)^0 \quad (13)$$
$$MH + OH^0 \rightarrow MHOH^0 \quad (14)$$
$$MH + H^0 \rightarrow M^0 + H_2 \quad (15)$$
$$MH + OH^0 \rightarrow M^0 + H_2O \quad (16)$$

and similar reactions with ($_{ag}e^-$), $(HO_2)^0$, and H_2O_2.

Biological Stage

At this stage, the effects are mediated by metabolic reactions, and changes may require seconds to years .At the cellular level a distinction is made between alterations in the DNA or chromosomes of germ cell and alteration in an ordinary body (somatic) cell. Changes in a germ cell may be expressed in offspring if that cell is involved in reproduction genetic effects). Alterations in other cells are expressed (if at all) in the individual irradiated .These changes may appear as an impairment of proliferative control, possibly resulting in cancer. Damage to development and differentiation may appear as abnormalities in a fetus irradiated in uterus. Degenerative changes, usually from impaired ability of cells to divide and grow (rather than outright cell death) ay appear as acute radiation sickness or a delayed manifestation such as cataract or general life – shortening[2] .

Some of the available published works about biological effects of thermal neutrons in mice were done and published [3 -10]

In The present work the thermal neutrons fluxes from Ra-Be (α,n) irradiation cell have been investigated and also the variation of the biological effects with the thermal neutron fluxes.

EXPERIMENTAL DETAILS

Eighteen male mice weighting 100 gm (16 days age) are relatively small male mice native to Libya, were used in this study . Animals were divided into six groups (3 animals each). The animals of the first group were kept as controls. The reminder groups irradiated with ($0.27x10^8$ N/cm^2.1h , $0.54x10^8$ N/cm^2.1h, $1.08x10^8$ N/cm^2.1h, $2.16x10^8$ N/cm^2.3h and 4.32x108 N/cm^2.6h) from irradiation thermal neutrons cell with neutron source Ra – Be (α,n) have activity 3 m. Ci made by lybold(55930) in physics department , faculty of science in El-Beida, Omar Almukhtar University, Libya. The blood of male mice (control and the treated samples)were analysed in a medical lab in El-Saura Hospital In El–Beida Lybia By using COULTER® A^c.T Series analyzer and the sysmex K -80 quantitative hematology analyzer.

RESULTS AND DISCUSSION

The data for this study summarized in Figs. 1,2,3,4 and 5.

Fig. (1) represents the relation between thermal neutron fluxes and number of white blood cells mm^{-3} (W. B. Cs. mm^{-3}) . from this fig. it is found that there are sharply decreasing in W. B. Cs. mm^{-3} for ($0.27x10^8$, $0.54x10^8$, and $1.08x10^8$ thermal neutron /cm^2 sec.) but above these fluxes there are slightly decrease in W. B. Cs. mm^{-3}).

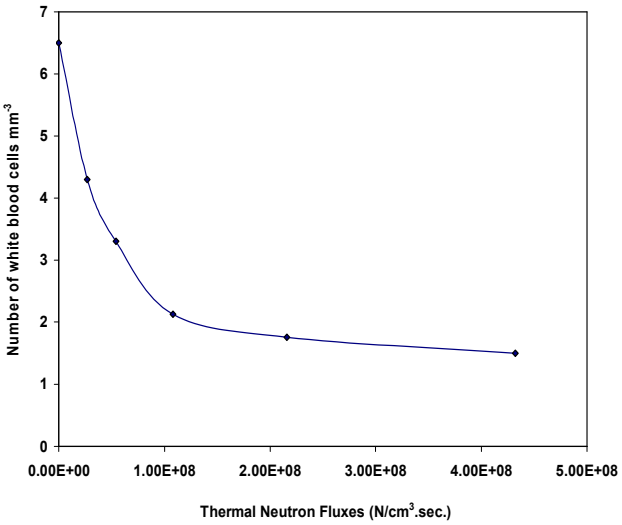

Fig. (1) Effect of Thermal Neutron Fluxes on the Number of White Blood Cells mm^{-3}

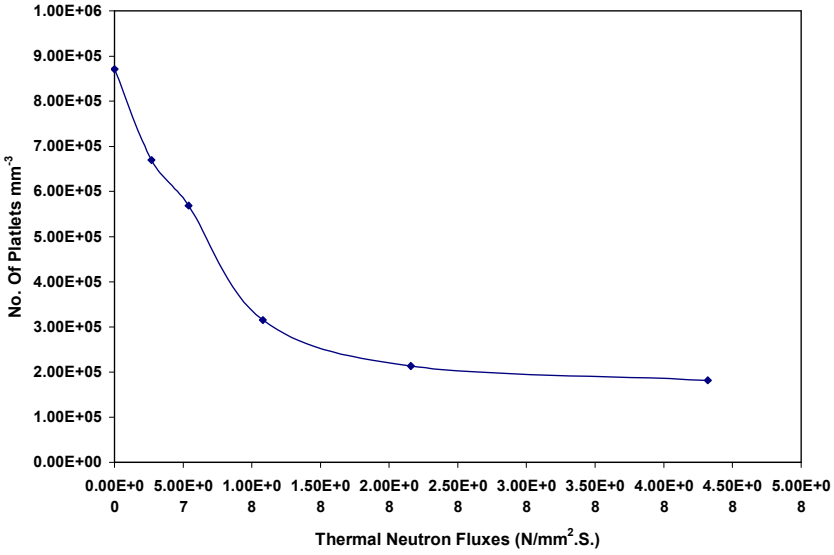

Fig.(2) Effect of Thermal Neutron Fluxes on number of platlets mm^{-3}

Fig. (2) shows the effect of thermal neutron fluxes on number of platelets mm^{-3}. In the region from $0.24x10^8$ to $1.08x10^8$ thermal neutron fluxes cm^{-2} $Sec.^{-1}$ there are sharply decreases , for higher fluxes it is found that there are slightly decrease with increasing the thermal neutron fluxes ,where this decreasing may be leads to blood

agglutination, blood coagulation, release serotonin substance which is vasoconstrictor and clot retraction so the bleeding time is prolonged[13].

Fig. (3) indicates that number of red blood cells in mm^{-3} (R. B. Cs. mm^{-3}) decrease sharply with increasing thermal neutron fluxes in the range from $0.24x10^8$, $0.54x10^8$, and $1.08x10^8$ neutrons cm^{-2} $Sec.^{-1}$, for the higher thermal neutron fluxes there are less decrease in number of (R. B. Cs. mm^{-3}) , where this decreasing may be leads to hypochromic anaemies[14]

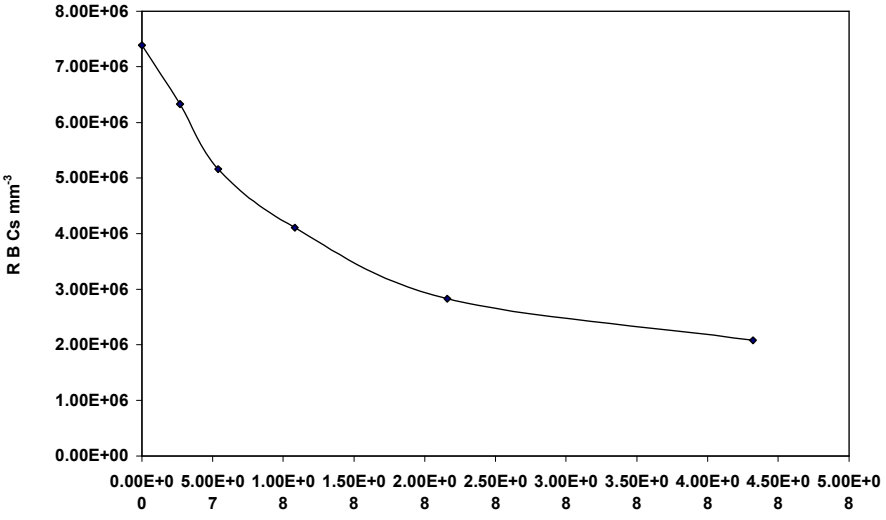

Fig.(3) Effect of Thermal Neutron Fluxes on number of Red Blood corpuscles per mm

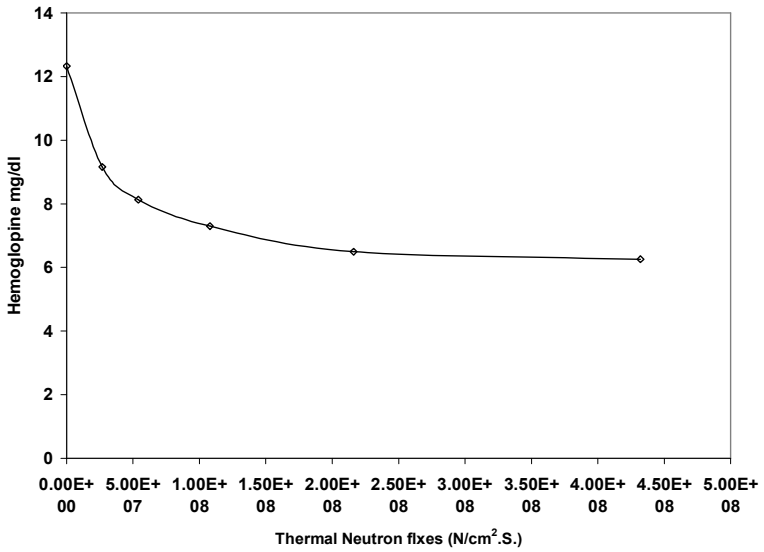

Fig.(4) Effect of Thermal Neutron Fluxes on the concentration of Hemoglopine in Blood mg/dl

Fig. (4) shows the effect of different thermal neutron fluxes on hemoglobin in Blood (mg/dl) for fluxes range from $0.24x10^8$, to $1.08x10^8$ there are sharply decreases in hemoglobin in blood (mg/dl) for the higher fluxes the figure indicate that there are slowly decrease with increasing thermal neutron fluxes.

Fig. (5) indicate the effect of thermal neutrons fluxes on differential counts of leucocytes percentages % . From this fig. it shown that neutrophiles percentages increases sharply with increasing thermal neutrons fluxes ($0.27x10^8$, $0.54\ x10^8$, and $1.08x10^8$) but for higher fluxes there are slowly increasing in neutrophiles percentages .

For lymphocytes it is shown that for $0.27x10^8$,$0.54x10^8$, and $1.08x10^8$ thermal neutrons fluxes , decreases sharply but above these fluxes it is found that there are slowly decrease in lymphocytes percentages .

In relation to monocytes it slightly increase with increasing thermal neutron fluxes in the region (from $0.27x10^8$ to $1.08x10^8$) but for higher fluxes the monocytes increase slightly .

For eosiniphil leucocytes it affected by thermal neutron fluxes where it decrease slightly with increasing the fluxes.

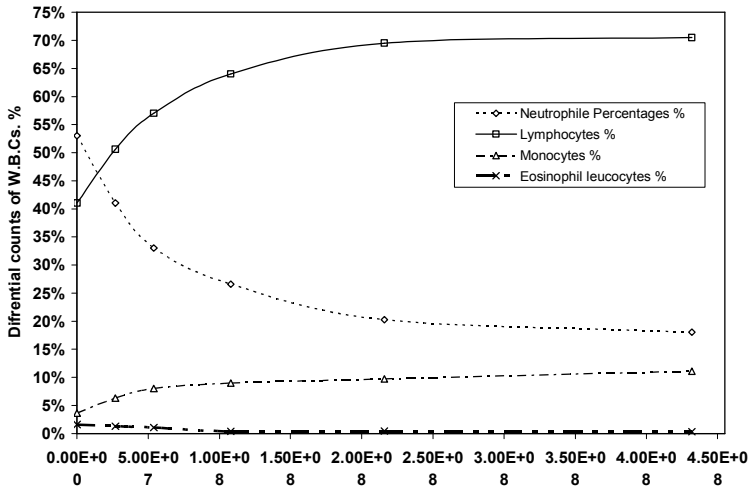

Fig. (5) Effect of Thermal Neutron Fluxes on the difrential count 0f W.B.Cs. Percetages %

CONCLUSION

From this study it is concluded that for the region from $0.24x10^8$ to $1.08x10^8$ thermal neutron fluxes, there are sharply decrease in number of white blood cells (mm^{-3}), number of red blood cells (mm^{-3}), hemoglobin in Blood (mg/dl) and lymphocytes percentage (%). For thermal neutron fluxes higher than $1.08x10^8$ there are slightly decreases in the former constituents of blood.

In relation to eosiniphil leucocytes percentage % there are slowly decreasing for all thermal neutron fluxes applied in this study.

Neutrophile percentages increases sharply with increasing thermal neutrons fluxes ($0.27x10^8$, $0.54\ x10^8$, and $1.08x10^8$) but for higher fluxes there are slowly increasing. But for eosiniphil leucocytes percentage it increases slightly by increasing thermal neutron fluxes

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