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Description of Skin Anatomical Structures of Wistar Rats Exposed to X-Rays Radiation

Gambaran Struktur Anatomi Kulit Tikus Wistar setelah Terpapar Radiasi Sinar-X

✉Lisdiana, Agus Ernawati

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Department of Biology, FMIPA, Semarang State University, Indonesia

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Abstract

The research was aimed to find out a profile of an anatomical structure of the *Rattus norvegicus* skin after exposed to X-ray radiation. Research was performed by treating the 20 Rattus norvegicus at the age of 1.5 months. The weight rats were weighed approximately 100 ± 13 g grouped into four treatments with different dose of X-ray radiation. The four treatments were 0 mgy (control), 50 mgy, 100 mgy, and 150 mgy X-ray radiation. The variable in this research was a dose of X-ray radiation and the anatomical structure of the rattus norvegicus skin. The data obtained were analyzed with qualitative description. The research results after exposure of X-ray radiation for 5-days showed that there was no damage on the skin macroanatomy. Whereas, the observation in the skin microanatomy showed that there was a damage, e.g. thinning of the epidermis, cell picnosys, cell injury, and hemoragic. The result indicated that the different dose of X-ray radiation affected the skin anatomy structure. The X-ray radiation exposure at 100 mGy on skin microanatomy were caused a thinning of the epidermis in stratum corneum layer, picnosys on the nucleus, cell injury and hemoragic.

Abstrak

Penelitian ini bertujuan untuk mengetahui gambaran struktur anatomi kulit tikus (Rattus norvegicu) strain Wistar setelah terpapar radiasi sinar-X. Sebanyak 20 ekor tikus umur 1,5 bulan dengan berat badan sekitar 100 ± 13 gram dikelompokkan ke dalam 4 perlakuan yaitu perlakuan dosis radiasi sinar-X sebesar 50 mGy, 100 mGy dan 150 mGy serta 1 kelompok kontrol. Paparan radiasi dilakukan selama 5 hari. Variabel penelitian ini adalah dosis paparan radiasi sinar-X dan struktur anatomi kulit. Data yang diperoleh dianalisis secara deskriptif kualitatif. Hasil penelitian menunjukkan bahwa secara makroanatomi kulit tikus tidak terlihat kerusakan, tetapi secara mikroanatomi terdapat kerusakan berupa penipisan epidermis, piknosis sel, jejas sel, dan hemoragik. Hal tersebut dikarenakan besarnya dosis radiasi mempengaruhi terhadap perubahan struktur anatomi kulit. Paparan radiasi sinar-X dosis 100 mGy, menimbulkan kerusakan kulit tikus secara mikroanatomi berupa penipisan epidermis dilapisan stratum korneum, piknosis inti, jejas sel dan hemoragik.

✉ Author Correspondence:
Gedung D6 Lt 1. Kampus Unnes Jl. Raya Sekaran Gunungpati, Semarang 50229
Telp/Fax.8508033 E-mail: lisdiana_512@yahoo.com

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INTRODUTION

An X-Rays radiation is a kind of radiation commonly known in a medical field in helping to diagnose a disease (Widyasari *et al.* 2005). One of the advantages of the X-Rays radiation is to detect the disease of abnormal organ through a radio diagnose. The use of X-Rays which is useful in the medical world should be aware because in spite of giving a useful information, it also can give dangerous effect to the living creatures' cells (Fauziyah & Dwijananti, 2013).

The radiation exposure will cause cell damage. The damage cell will influence the function of tissue or organ if the amount of death or broken cell in the tissue is quite a lot. The response from various tissue and organ to the radiation varies. Besides depending on the physical nature of radiation, it also depends on the biological characteristic of the composer of tissue or organ which is exposed (Kurniawan & Ida, 2008).

Body consists of several of organs such as skin, liver, kidney, lung, vertriculus, and many other. Skin is an elastic wrapper protecting the body from environment influence. It composes from different tissues such as blood vessel, connective tissue, fat, glands, senseing organ and nerve. When the outside organ is exposed by the X-Rays so the inside organ is exposed also. Skin for the living creatures has an important role as a protection from the outside nuisance like protecting the body from radiation, chemical substance, microorganism, and balancing the body temperature (Geneser, 1994).

When the X-Rays radiation contacts and penetrates the skin so the skin tissue composer will be broken. The ravage of the skin tissue because of over exposure will cause a skin malfunction, so the body protection toward the outside disturbance will be weak. From the point of view of how skin is important, so the research of the effect of X-Rays radiation exposure to the description of skin anatomical structures needs to be done.

METHODS

This research was done in the Physic and Biology Laboratory of Semarang State University, and also in the BBVET laboratory. This research used 20 female white rats (*Rattus norvegicus)* strain Wistar and the weight approximately 100 ± 13 gram and their age are 1,5 month. The research method uses a complete random design one factor with 4 treatments and 3 repetitions on each treatment. The radiation used as the treatment comes from radio diagnostic machine SF100BY with the power specification *supply voltage*: 180-240 V, *kilo voltage*: 50-100 kV, *time*: 0.08s~6.3s, energy: 120 eV until 120 KeV, target anode: tungsten (W) and the radiation dose is measured by radiography diagnostic. *Rattus norvegicus* is grouped into 4 treatments. Each treatment consists of 5 rats. The four groups of treatment are given the radiation doses that are: 50 mGy, 100 mGy, 150 mGy and 0 mGy as a controller. In giving the doses, the dose giver is based on the Fauziyah and Dwijananti (2013) research. The radiation is given for 5 days in a row. After the last day exposure, the rat is shaved and its skin is taken. The skin then is incorporated into formalin solution 10% in order to be made as a histology smear. The observation result is done by comparing the skin organ in a normal condition to a treatment condition. The observation of the skin anatomical structure is done by shaving the rat's hair including the absence of erythema, epilation, skin desquamation, and necrosis. Microanatomical observation is done by using a radiance microscope with 400 times optical zoom and HE coloring including the alternation of cell structure in the dermis and epidermis layer covering the absence of picnosis cell, karyorrhexis, karyolysis, and necrosis.

RESULTS AND DISCUSSION

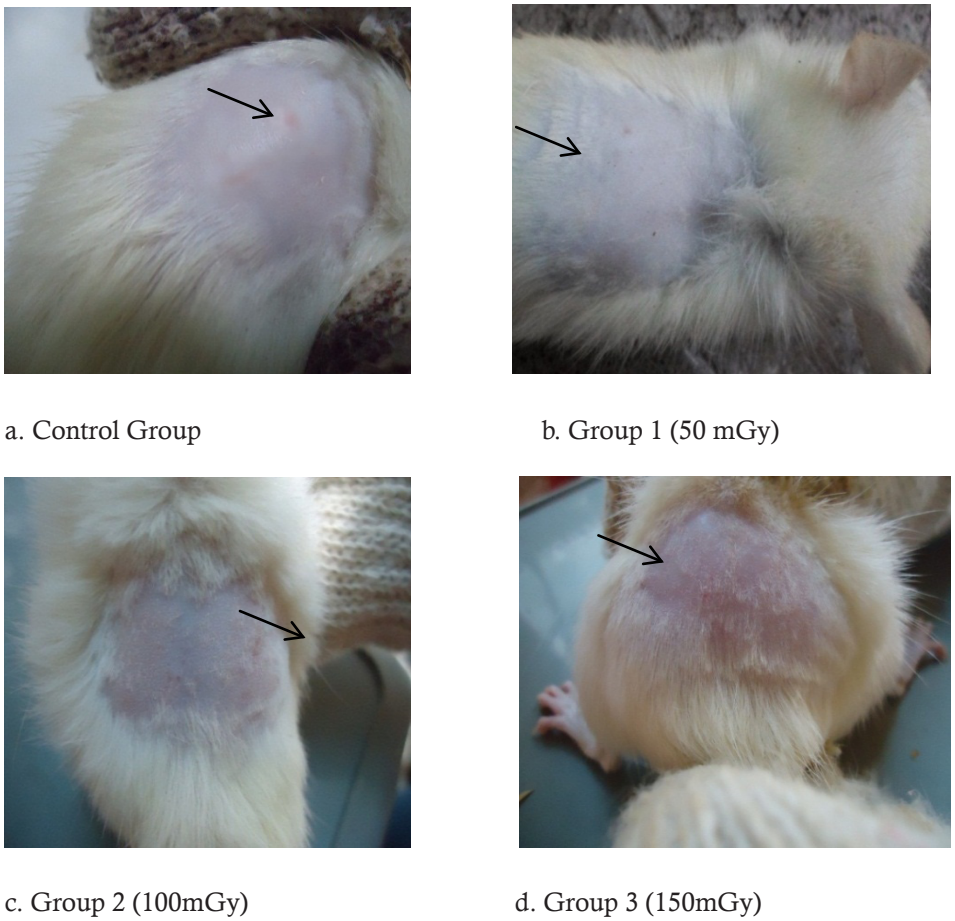
The Illustration of microanatomical skin structure of *Rattus norvegicus*

From the observation result, the treatment of the X-rays radiation exposure on 20 rats with doses of 50 mGy, 100 mGy, and 150 mGy for 5 days in a row tells that the result shows insignificant different for the control group. The condition of the skin surface on the treatment rat is in a normal condition. The observation result of the treatment rats' skin surface in each treatment can be seen in the Figure 1 as follows:

The observation result on the treatment of control group (Figure a) the rat's skin looks normal, white, and clean. Treatment on 2 and 3 (Figure b and c), the rat's skin still looks normal but there is a little red spot in the skin. The red spot, as seen at the Figure b and c, is still normal. The skin experiences a ravage if the erythema appears or if there is a bruise.

The illustration of the Microanatomical Structure of Rat's skin

The observation result on the alteration of microanatomical skin from the Hematoxilin-Eosin coloring which is seen under the radiance



a. Control Group

b. Group 1 (50 mGy)

c. Group 2 (100mGy)

d. Group 3 (150mGy)

Figure 1. Microanatomical of the rat's skin structure after exposed by the X-rays radiation

microscope showing that the skin on the control group is in the normal condition, it is seen orderly with three layers; they are epidermis, dermis, and hypodermis (subkutan) (Figure 2).

The radiation exposure on the skin can cause a degradation of epidermis layer. It consistent with the research of Abuarra *et al.* (2002) which states that the ravage of the skin tissue is increasing gradually and it is marked by the thinning of the epidermis also by losing of stratum corneum layer. This agrees with the illustration of the skin structure which is exposed by X-rays radiation as shown in the Figure (3, 4, and 5)

The skin obtaining the exposure of X-rays radiation treatment 100 mGy seems having an alteration in the microanatomical structure that is hemoragic in the dermis layer, the injury of the cell, and the finding of core picnosis.

The illustration of microanatomical structure on the treatment 3 (dose 150 mGy) shows that the epidermis layer looks thinner. The border of papila dermis is seen unclear. Many of the core of picnosis appears. On the dermis layer, the injury of the cell happens and the sudorifera gland is swelling.

Based on the reseach result on the wistar rat which is exposed by the X-rays radiation in 5 second for 5 days in a row shows that in the illustration of macroanatomical structure of the skin, there is no discrepancy between the control group and the treatment group. In the control group, the skin seems normal after exposed by the X-ray radiation, the skin surface is smooth, white, and clean. The skin condition after exposed by the X-ray radiation doses 50 mGy, 100 mGy, and 150 mGy remains the same as the control group. This is because the alteration of macroanatomical structure happened if the skin is exposed by the high dose (2Gy) of radiation or the big of the dose influences the change of the macroanatomical structure of the skin (Alatas 1998).

The lowest dose of the X-ray radiation which contacts the skin is 2 Gy. The dose under 2 Gy does not affect the macroanatomical structure of the skin (Stecker *et al.* 2009). The radiation exposure 2-5 Gy which contacts the skin will cause a light erythema. Erythema is the skin damage because the blood vessel is swollen, so it turns the

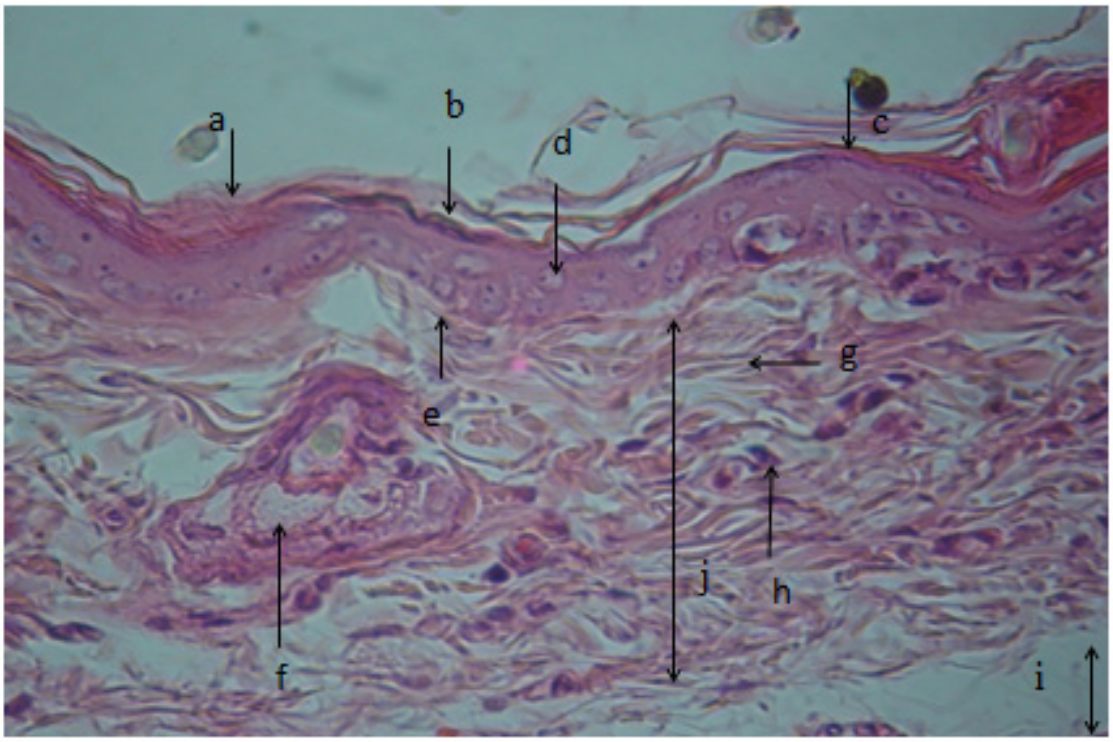


Figure 2. Microanatomical Structure of the Rat's Skin in the Control Group (400 times optical zoom with HE coloring)

Note

a. Stratum corneum	f. Sebaceous glands
b. Stratum lucidum	g. Fiber kolagen
c. Stratum granulosum	h. Fiber kolagen
d. Stratum spinosum	i. Dermis
e. Stratum germinativum	j. Subkutan

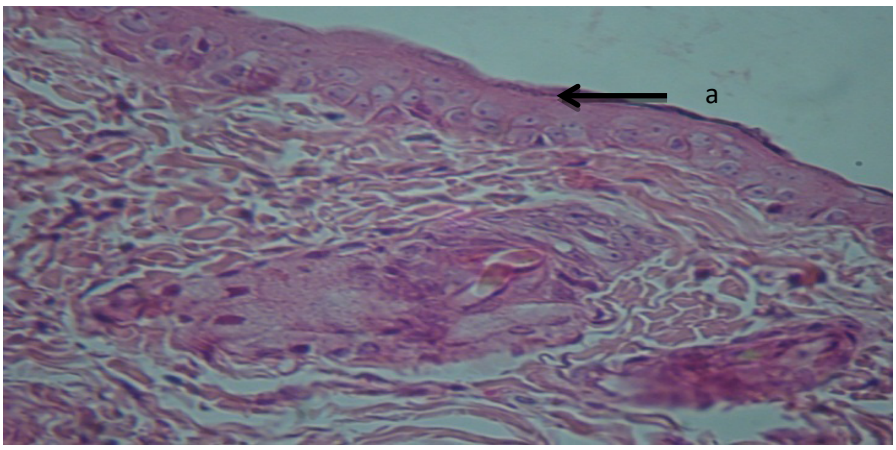


Figure 3. Microanatomical Structure on the Rat's Skin after Exposed by the x-Ray Radiation Dose 50 mGy (400 times optical zoom with HE coloring).

Note: a. the thinning of epidermis layer

skins to red. This process can be caused by the high dose of radiation with shorter length of the wave. The symptoms are the red skin, warm, and bruise. Those effect are can be seen directly, the effect which can be examined directly after exposed by the high dose of radiation (Anitha, 2012).

The observation result in the microanatomical skin is known that there is the difference between the control group and treatment group. In the experimental rat, the epidermis layer looks

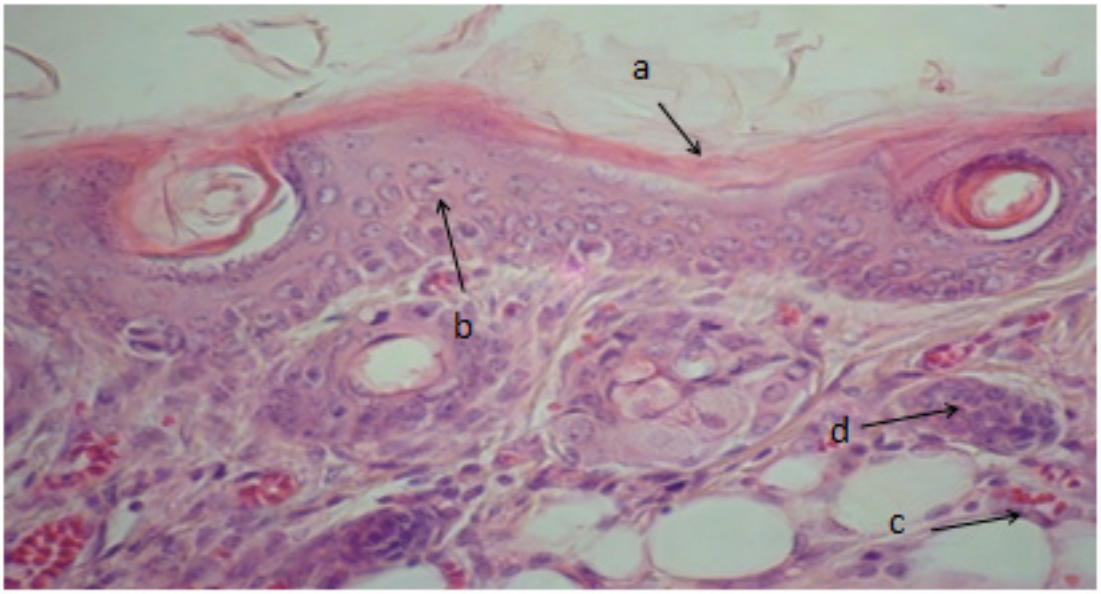


Figure 4. Microanatomical Structure on the rat's skin after exposed by the x-ray radiation dose 100 mGy (400 times optical zoom with HE coloring).
Note: a. The thinning of stratum corneum, b. the core of the picnosis, c. Hemoragic, d. The injury of the cell

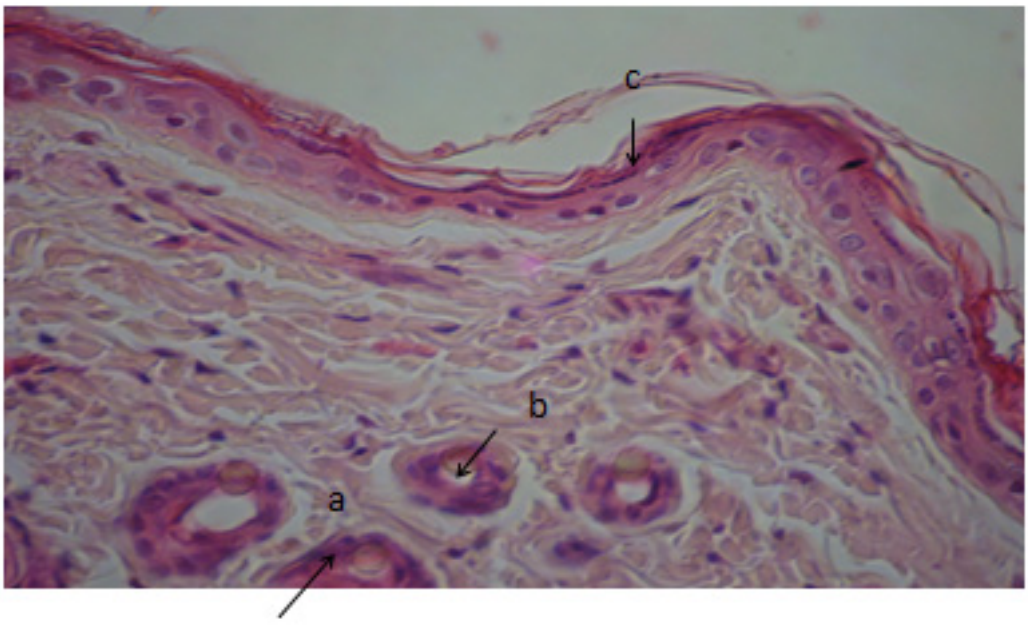


Figure 5. Microanatomical Structure on the rat's skin after exposed by the x-ray radiation dose 150 mGy (400 times optical zoom with HE coloring).
Note: a. the core of the picnosis, b. The injury of the, c. The thinning of epidermis layer

thinner than before, the injury of cell happens, the core of picnosis appears, and the hemoragic is happened. The change of the microanatomical skin is caused by the effect of photo thermal from the X-ray radiation. Cell is not be able to restrain the heat given, so the cell's form is changing. Abuarra *et al.* (2012) explains that the effect of photo thermal can alter the skin tissue including the thinning of epidermis, swelling cell, and the change of colagen dermal.

The radiation exposure can cause the alteration to the skin. The heat that comes from X-ray will cause the epidermis damage then it can form the picnosis cell. The picnosis cell is an early

stage to the cell death because of the radiation exposure (Shantiningsih *et al.* 2013).

The weakest cell which often damage because of the radiation exposure is the cell which experiences a mitosis so often such as the epitel cell in the digestive system, integumen cell, and the blood forming cell in the spinal cord (Corwin 2007). Proliferated cell will experience a damage if the radiation is given in the medium dose (1-2 Gy). If the cell having a broader DNA ravage or if it is not able to repair the damage, so the cell will do an apoptosis. The living cell can show the effect of ion radiation slowly that are mutation, aberation, chromosom, and genetic unstable. The damage cell genetically will be ferocious and become cancer (Mitchell *et al.* 2008).

Based on the research, the skin damage is not seen in the macroanatomical structure, but it is seen in the microanatomical structure. This is occurred because of the main target of the radiation is DNA which is inside the cell, so the damage or the alteration are seen in the cell level first (Alatas, 2004). This relates to the X-ray radiation exposure doses 50 mGy, 100 mGy, and 150 mGy, which is shown the alterations of microanatomical structure.

CONCLUSION

The study alowed that the X-ray exposure reaching 150 mGy dose on the female white rat strain Wistar did not affect the macroanatomical structure of the skin, but microanatomically, it showed damage on the epidermis cell such as the thinning of *stratum corneum*, the core of the picnosis, the injury of the cell, and hemoragic. By 100 mGy, microanatomically, it showed the damage among the epidermis layer; stratum corneum, core of the picnosis, injury of the cell, and hemoragic apperance.

REFERENCES

Abuarra, A., Basma, A., Basher, S. A., Gurjeet KCS, Zedan, A., Lina, T. G., Mahmood, R., Khalid, O., & Matjafri, M. Z. (2012). The Effects of Different Laser Doses on Skin. *International Journal of The Physical Sciences,* 3(7), 400-407.

Alatas, Z. (1998). Efek Radiasi pada Kulit. *Buletin Alara,* 2(1), 27-31.

---------. (2004). Efek Radiasi Pengion dan Non-pengion pada Manusia. *Buletin alara,* 5(2&3), 99-112.

Anitha, T. (2012). Medical Plants Used in Skin Protection. *Asian Journal of Pharmaceutical and Clinical Research,* 5(3), 40-43.

Corwin, E. J. (2007). *Buku Saku Patofisiologi*. Jakarta: Buku Kedokteran EGC.

Fauziyah, A., & Dwijananti. (2013). Pengaruh Radiasi Sinar-X terhadap Motilitas Sperma pada Tikus Mencit (*Mus muculus). Jurnal pendidikan Fisika Indonesia,* 9, 93-98.

Fauziyah, F. F., Unggul, P. J., & Sri, H. (2012). Pengaruh Pemberian Buah Manggis, Buah Sirsak dan Kunyit Terhadap Kandungan Radikal Bebas pada Daging Sapi yang Diradiasi dengan Sinar Gamma. *Physics Student Journal,* 1(1), 24-31.

Finn, G. (1994). *Buku Teks Histologi Jilid 2*. Jakarta: Binarupa Aksara.

Kurniawan, B., & Ida, W. (2008). Hubungan Radiasi Gelombang Elektromagnetik dan Faktor Lain dengan Keluhan Subyektif pada Tenaga Kerja Industri Elektronik GE di Yogyakarta. *Promosi Kesehatan Indonesia*, 3, 127-133.

Mitchell, R. N., Kumar, Abbas & Fausto. (2008). *Buku Saku Dasar Patologis Penyakit Edisi 7*. Jakarta: Buku Kedokteran EGC.

Shantiningsih, R. R., Silvana, F. D., Allen, A., Aldodi, I. S. (2013). Increasing the Number of Micronucleus from Dental Radiation Effect Until 14 th Day After Exposure. *Proceeding bookthe International Symposium on Oral and Dental Sciences.* Jogyakarta: Universitas Gajah Mada Jogyakarta.

Stecker, M. S., Stephen, B., Richard, B. T., Donald, L. M., Eliseo, V., Gabriel, B., Fritz, A., Cristhine, P. C., Alan, M. C., Robert, G. D., Dixon, Kathleen, G., George, G. H., Beth, S., John, D. S., Thierry, D. B., & John, F. C. (2009). Guidelines for Patient Radiation Dose Management. *J Vas Interv Radiol,* 20(7S), S263-S273.

Widyasari, E., Shanty, L. & Artini, P. (2005). Pengaruh Iradiasi Sinar-X terhadap Produksi Antibodi Mencit Galur BALB/c dengan Pemberian Vaksin Toksoid Tetanus. *Bioteknologi,* 4(1), 13-19.