International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

Effect of Giving Mangrove Leaf Extract (Acanthus Ilicifolius) and Teak Leaf Extract (Tectona Grandis) on Iron (Fe) Beef Exposed to Gamma Radiation

Dian K. A Berebein[1], Chomsin S. Widodo[2], Sri Herwiningsih[3]
[1]Magister Program, Department of Physics, Brawijaya University, Malang, Indonesia-65145
[2,3]Department of Physic, Brawijaya University, Malang, Indonesia-65145

Abstract— *This study uses beef given gamma radiation exposure and uses a mixture of mangrove leaf extract (acanthus illicifolius) and teak leaf extract (Tectona grandis) as an antioxidant that can reduce the formation of abnormal iron (free iron) in beef which will be a catalyst and is a major factor in the formation of free radicals that destroy the nutritional content in beef. This study aims to determine the effect of gamma radiation exposure on the amount of iron (Fe) beef as well as to determine the effect of giving a mixture of mangrove leaf extract (acanthus illicifolius) and teak leaf extract (Tectona grandis) on beef exposed to gamma radiation. This study used 600 pieces of beef, dice size (1 cm x 1 cm x 1 cm x 1 cm) with a weight of 0.5 gram each, and grouped in groups exposed to radiation and given a mixture of extracts. Antioxidants are given in 3 concentrations of 2%, 6% and 10%. While gamma radiation exposure is given for 1 hour, 2 hours, 3 hours, 4 hours and 5 hours. Analysis of iron content was carried out using the SSA (Atomic Absorption Spectrophotometry) method. The results showed that exposure to gamma radiation can cause an increase in the amount of iron (Fe) which can be seen from the high percentage of the amount of iron (Fe) measured from the test results. However, the administration of a mixture of the two extracts showed a decrease in iron (Fe) levels with the best reduction results at low extract concentrations.*

Keywords— *AAS, Beef Iron (Fe) Gamma Radiation, Mangrove leaf extract (acanthus ilicifolius) and Teak leaf extract (Tectona grandis).*

I. INTRODUCTION

Starting from the increasing needs of the community for fresh and durable food supplies, the industrial world is rapidly developing preservation technology that is fast and also practical. The preservation technology has rapidly developed in the last few decades is the preservation method using irradiation. The radiation source used in food preservation is gamma rays produced by 60Co and 137Cs [1]. The use of radiation technology in preservation can have a good interaction effect which can inhibit the growth of microbes and other bacteria. But it cannot be denied that the energy from the source of radiation used can affect other healthy tissues that are in the vicinity of microbial and bacterial growth. This interaction can cause changes, including structural changes in the nutrients contained in meat. Beef is one of the red meats with high iron (Fe) content. In 100 grams of meat contained 2.8 grams of iron (Fe). Beef processing by irradiation method can cause changes in iron function to be a catalyst for forming free radicals that can affect the presence of other nutrients contained in beef. When free radicals attract electrons, it triggers a chain reaction that increases the number of free radicals. If free radicals are not deactivated, their reactivity can damage all types of cellular macromolecules, including carbohydrates, proteins, lipids, and nucleic acids [2].

Atomic absorption spectrophotometry (AAS) is an elemental analysis method whose measurement is based on the absorption of light of a certain wavelength by metals (Supong, 2019). If a light with a certain wavelength in a cell contains free atoms, then some of the light will be absorbed and the absorption intensity is directly proportional to the number of metal-free atoms in the cell [3].

The increase in the amount of iron after irradiation which is known from the results of the SSA test shows that the measured iron (Fe) is free iron (Fe) which can be a catalyst for forming free radicals. One way to prevent free radicals arising from beef radiation is to provide a source of antioxidants derived from natural ingredients. Antioxidants are compounds that can neutralize radicals formed after irradiation. Teak leaves contain secondary metabolites, including flavonoids, saponins and steroids / triterpenoids. Besides having flavonoid content that can prevent the emergence of free radicals, teak leaf extract also contains polyphenol compounds which can help increase the absorption of iron that changes, when iron (Fe) hem becomes iron that is difficult to absorb [4]. The mangrove leaves contain biologically strong flavonoid class active substances, namely Quercetin [5]. If vitamin C has antioxidant activity 1, then quercetin has antioxidant activity 4.7 times stronger [6].

II. RESEARCH METHOD

This research was conducted using 600 pieces of diced fresh beef weighing 0.5 grams per piece of meat and grouped into groups without irradiation, irradiation group without extracts and irradiation group with a mixture of the two extracts using 30 pieces of beef according to the size that has been determined in each group. Radiation exposure is given with a variation of time 1 hour, 2 hours, 3 hours, 4 hours to 5 hours. Extracts were given varied in three concentration groups at concentrations of 2%, 6%, and 10%. The second mixture of the extract with meat is given by maceration, which is extracted into the meat and left for some time until the extract is absorbed evenly in meat, after which it is given radiation exposure.

Radiation sources used include Cs-137 with an activity of 17.1 Bq and Co-60 with an activity of 1.33 x 10-3 Bq. The

Dian K. A Berebein, Chomsin S. Widodo, and Sri Herwiningsih, "Effect of Giving Mangrove Leaf Extract (Acanthus Ilicifolius) and Teak Leaf Extract (Tectona Grandis) on Iron (Fe) Beef Exposed to Gamma Radiation," *International Research Journal of Advanced Engineering and Science*, Volume 5, Issue 3, pp. 21-23, 2020.

radioactive source is placed in a container in the form of a rectangular irradiation template made from styrofoam material which is given hole 3 according to the number of radioactive sources used. The irradiation condition is carried out using SSD (source to surface distance) in a 10 cm box, from the bottom of the box and the irradiation area of 10 cm x 3 cm. During the irradiation process, the surrounding area is covered with lead sheets. The determination of the area of the irradiation field was carried out to determine the area of radiation coverage from the irradiation distance of 10 cm towards the beef sample.

Fig. 1. Gamma Irradiation in Beef

Figure 1 is the process of exposure to gamma radiation in beef samples. Meat samples tested by spectrophotometry amounted to 30 pieces of meat samples that were exposed to gamma radiation in the previous treatment without being reduced or added After the exposure process by each group, an iron content (Fe) test will be carried out by atomic absorption spectrophotometric analysis (AAS).

III. Result and Discussion

In this study, data were obtained in the form of iron content (Fe) before and after radiation exposure treatment. The relationship between the duration of exposure to the amount of iron content (Fe), showed the results of a significant increase.

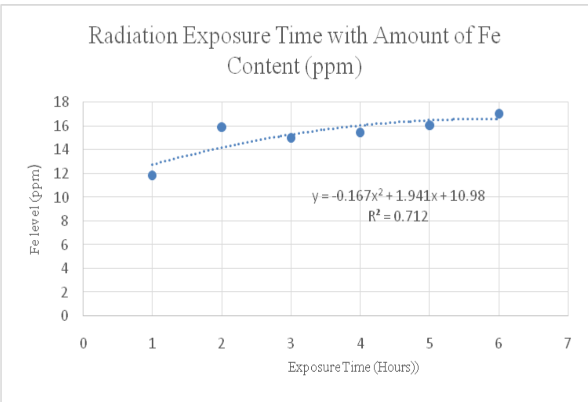

Fig. 2. Relationship between exposure time and total iron content (Fe).

The relationship between the length of time exposure to the amount of iron content (Fe) is shown in (figure 2). If the structure of the iron-binding porphyrin and protein changes, an increase in iron (Fe) is a free iron (Fe). Radiation exposure given with 5-time variations shows the longer the time of exposure, the increasing the amount of iron (Fe). Increasing the amount of free iron can be a good catalyst in the formation of free radicals, other nutritional destroyers contained in beef. The administration of a mixture of mangrove (acanthus illicifolius) and teak (Tectona grandis) leaf extracts in beef as a deterrent to the effects of gamma radiation has an impact on reducing the amount of iron, as shown in (figure 3). However, the administration of this extract showed the best decrease in the administration of a low extract concentration.

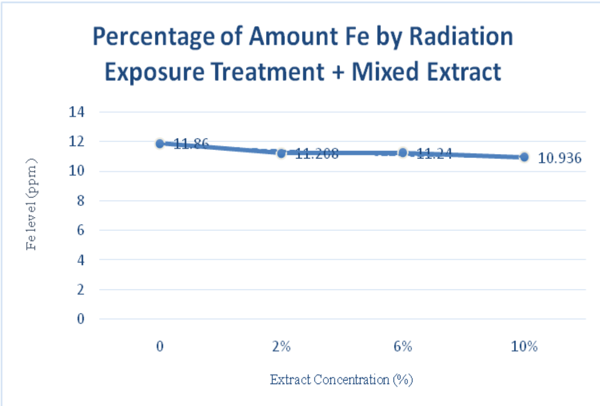

Fig. 3. Relationship between the Administration of Mixed Extracts and the Amount of Iron (Fe).

Gamma radiation is ionizing radiation that can cause damage to the material in its path [7]. The interaction between radiation and material causes damage or structural changes in the nutrient content of the material. The increase in the amount of iron is caused by the breakdown of the pofirin chain which causes the release of iron and protein bonds causing iron-overload or iron overload [8]. Circulation of iron (Fe) without bonding with certain molecules, including one of the bindings of proteins, can cause changes in iron (Fe) to be toxic which catalyzes free radicals and then can cause damage to cells [9]. The formation of free radicals from changes in iron (Fe) can increase oxidation in proteins, peroxidation of fat membranes and modify nucleic acids [10]. Based on research results, it appears that a mixture of mangrove leaf extract (acanthus illicifolius) and teak leaf extract (Tectona grandis) at low concentrations (2%) can prevent an increase in the amount of iron (Fe) after radiation exposure. The mixture of the two extracts gives a good synergy effect of each compound contained therein. The quercetin content of flavonoid derivatives contained in a powerful mangrove leaf extract can work as an antioxidant, can prevent the formation of free radicals that can damage other nutrients in beef. Meanwhile, the content of polyphenols in teak leaf extract can support the work function of ascorbic acid so that it can maintain meat stability in several aspects, due to changes in the structure of porphyrins [11].

However, the administration of extracts containing polyphenols can have a less beneficial effect if given excessively to meat because excessive polyphenol compounds can be compounds that facilitate the low absorption of iron. Therefore, the administration of a mixed extract in this experiment was carried out so that the synergy of the two extracts could occur, where several active compounds from each extract could increase the effectiveness of the extract as a whole [12].In addition to the quercetin content of a strong flavonoid derivative, there is also a polyphenol content from the ascorbic acid group that can maintain the stability of the color of the meat due to changes in the structure of porphyrin [11].

IV. Conclusion

The administration of a mixture of the two extracts resulted in a decrease in the amount of iron (Fe) at each concentration, with the amount closest to the value in the control sample at a concentration of 6%. This shows the interaction between the extract given with the changes that occur in the binding of iron molecules in meat so that it can neutralize the formation of free iron that can damage cells.

References

[1] G. Wu, *Radiation Sources and Radiation Processing*. Elsevier Inc., 2019.

[2] R. Akki *et al.*, “Adaptation to oxidative stress at cellular and tissue level,” *Arch. Physiol. Biochem.*, vol. 0, no. 0, pp. 1–11, 2019, doi: 10.1080/13813455.2019.1702059.

[3] Y. J. Gong, M. K. Lv, M. L. Zhang, Z. Z. Kong, and G. J. Mao, “A novel two-photon fluorescent probe with long-wavelength emission for monitoring HClO in living cells and tissues,” *Talanta*, vol. 192, pp. 128–134, 2019, doi: 10.1016/j.talanta.2018.08.089.

[4] G. J. Anderson and D. M. Frazer, “Current understanding of iron homeostasis,” *Am. J. Clin. Nutr.*, vol. 106, no. C, pp. 1559S-1566S, 2017, doi: 10.3945/ajcn.117.155804.

[5] A. Saranya, T. Ramanathan, K. S. Kesavanarayanan, and A. Adam, “Traditional Medicinal Uses , Chemical Constituents and Biological Activities of a Mangrove Plant , Acanthus ilicifolius Linn . : A Brief Review Pharmacology and Toxicology Research Laboratory , Faculty of Pharmacy ,” *Am. J. Agric. Environ. Sci.*, vol. 15, no. 2, pp. 243–250, 2015, doi: 10.5829/idosi.aejaes.2015.15.2.12529.

[6] D. Xu, M. J. Hu, Y. Q. Wang, and Y. L. Cui, “Antioxidant activities of quercetin and its complexes for medicinal application,” *Molecules*, vol. 24, no. 6, 2019, doi: 10.3390/molecules24061123.

[7] K. A. C. Adelia, C. S. Widodo, and J. A. E. Noor, “Effect Extract of Soursop Leaf (Annona Muricata) and Mangosteen Peel (Garcinia Mangostana) on SGPT Level in the Liver of Mice (Mus Musculus) Exposure to Gamma Radiation,” *Int. Res. J. Adv. Eng. Sci.*, vol. 4, no. 1, pp. 244–246, 2019.

[8] E. N. Heather A Leitch, *Chapter 5 : iron physiology, iron overload, and the porphyrias*, 5th ed. 2019.

[9] P. Brissot, M. Ropert, C. Le Lan, and O. Loréal, “Non-transferrin bound iron: A key role in iron overload and iron toxicity,” *Biochim. Biophys. Acta - Gen. Subj.*, vol. 1820, no. 3, pp. 403–410, 2012, doi: 10.1016/j.bbagen.2011.07.014.

[10] Y. J. Yauger, S. Bermudez, K. E. Moritz, E. Glaser, B. Stoica, and K. R. Byrnes, “Iron accentuated reactive oxygen species release by NADPH oxidase in activated microglia contributes to oxidative stress in vitro,” *J. Neuroinflammation*, vol. 16, no. 1, pp. 1–15, 2019, doi: 10.1186/s12974-019-1430-7.

[11] K. C. Nam *et al.*, “Effect of dietary vitamin E and irradiation on lipid oxidation, color, and volatiles of fresh and previously frozen turkey breast patties,” *Meat Sci.*, vol. 65, no. 1, pp. 513–521, 2003, doi: 10.1016/S0309-1740(02)00243-7.

[12] M. I. Fitrianda, “Digital Digital Repository Repository Universitas Universitas Jember Jember Digital Digital Repository Repository Universitas Universitas Jember diakses tahun 2018,” 2016.

Dian K. A Berebein, Chomsin S. Widodo, and Sri Herwiningsih, “Effect of Giving Mangrove Leaf Extract (Acanthus Ilicifolius) and Teak Leaf Extract (Tectona Grandis) on Iron (Fe) Beef Exposed to Gamma Radiation,” *International Research Journal of Advanced Engineering and Science*, Volume 5, Issue 3, pp. 21-23, 2020.