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GAMMA RADIATION PROCESSING ON TEMULAWAK (*Curcuma xanthorrhiza* Roxb) AND OTHER ZINGIBERACEAE

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ABSTRACT

GAMMA RADIATION PROCESSING ON TEMULAWAK (*Curcuma xanthorrhiza* Roxb) AND OTHER ZINGIBERACEAE. Indonesia, as tropical country has high ambient temperature and humidity which make raw materials and herbal medicines vulnerable to damage. Gamma irradiation processing offers a wide range of application to reduce post harvest losses of medicinal plants and it can also be used to improve the hygienic of raw materials as well as herbal medicine products. The research activities on radiation processing of zingiberaceae in Indonesia in 1980s were intended for: sprouting inhibition of fresh rhizome, microbiological reduction and elimination of pathogenic microbes in raw materials and herbal medicines. The samples used in this experiments were temu-lawak (*Curcuma xanthorrhiza* Roxb), temu-hitam (*Curcuma aeruginosa*), turmeric (*Curcuma domestica*) and galanga (*Kaemferia galanga*). Physico-chemicals characteristics of samples were studied to support the application of radiation processing as a preservation technique of medicinal plants as raw material or its products. The results indicated that gamma irradiation at dose of 10 kGy was sufficient to reduce microbes by 2 – 4 log cycles which contaminated the dried rhizome. Sprouting of fresh rhizome of 4 samples in the study could be retarded at dose range of 0.06-0.08 kGy. The effect of gamma irradiation at the maximum dose of 0.25 kGy (sprouting inhibition dose) and maximum dose of 10 kGy (pasteurization dose) on physico-chemical characteristics of four samples were studied and reported in this paper.

Keywords : *Curcuma xanthorrhiza* Roxb, zingiberaceae, radiation processing, pasteurization, sprouting inhibition, physico-chemical

INTRODUCTION

Indonesia has a long history in traditional/herbal medicines. The knowledge of herbal medicines are heredited from generation to generation over centuries in different communities and some have been crystallized and have even led to the discoveries and development of a large number of drugs that are now used regularly as well-trusted therapeutic agents. Herbal medicines has not only continued to be used as primary health care for the poor, and for various level in the communities, but also play a very important role in providing health care for the people (1, 2, 3).

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The industries of herbal medicines in Indonesia show a tendency of growth, consisting of 10% large-scale industries and 90% small-scale industries. The number is still growing, as it can be observed by modern pharmaceutical industries jumping into developing and producing herbal medicines as well (1, 4).

As a tropical country, Indonesia has high temperature and humidity that make medicinal plants as raw materials and herbal medicines vulnerable towards damage caused by sprouting of rhizome, insect infestation, mould, and bacteria contamination. To overcome the problems, several efforts such as UV radiation and gaseous sterilization technique have been done by industries but the results are still unsatisfactory. Therefore, development of new technologies, such as radiation processing is still needed (5, 6, 7).

Radiation processing offers a wide range of applications such as reducing post harvest losses and improving the hygienic of herbal medicines. The studies on temu-lawak (*C. xanthorrhiza* Roxb) and other zingiberaceae were conducted during the 1980's in Indonesia. Activities in this field are centralized at the Center for Application of Isotopes and Radiation Technology, National Nuclear Energy Agency (CAIRT – NNEA) in Jakarta (8, 9, 10, 11).

The present status of researches on radiation processing of temu-lawak *(C. xanthorrhiza* Roxb*)*, galanga (*K.* galanga), turmeric *(C. domestica)* and temu-hitam *(C. aeruginosa)* is described.

IRRADIATION FACILITY

Three gamma irradiation facilities are available at the centre for Application of Isotopes and Radiation Technology, National Nuclear Energy Agency in Jakarta, namely Gamma Chamber, Panoramic Batch Irradiator and Latex Irradiator. The three gamma irradiation facilities use cobalt-60 as a source with the maximum capacity of 10 kCi (in 1995), 75 kCi (in 1979) and 400 kCi (in 1983), respectively. The last two facilities can be used for pilot scale study on radiation processing of raw materials and herbal medicines and simultaneously for providing irradiation services to semi commercial proposes. Currently, there is one gamma facility in Cibitung, West Java, namely REL-

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ION, with 6 MCi maximum building capacity of a cobalt-60 source and at present the cobalt-60 source capacity is 366, 726 kCi. This facility is run by private sector in providing irradiation services to manufactures of herbal medicines, pharmaceuticals, food, cosmetics etc.

RADIATION PASTEURIZATION OF DRIED RHIZOME

The ionizing radiation using gamma ray is an effective method for elimination of bacteria and mould contamination in raw materials as well as in herbal medicine products. This technology has been well accepted in several pharmaceutical, cosmetics and herbal medicine industries in Indonesia. Microbial contaminations in raw materials introduce a great problem especially during preparation and storage of herbal medicine products. The overall quality of the product mostly depends on hygienic quality of the raw materials. Temu-lawak (*C. xanthorrhiza* Roxb), temu-hitam (*C. aeruginosa*), galanga (*K. galanga*) and turmeric (*C. domestica*) are indigenous Indonesian plants. The dried tuberous roots of these plants are used as main raw materials of herbal medicine products.

The use of gamma irradiation for pasteurization of dried rhizome should be combined with suitable packaging in order to avoid recontamination during distribution and storage. Radiation pasteurization, which is recommended is described as follows. Samples of temu-lawak (*C. xanthorrhiza* Roxb), temu-hitam (*C. aeruginosa*), galanga (*K. galanga*) and turmeric (*C. domestica*) slices were dried down into moisture content ranging from 8% to 14%. After this samples were then packed in LDPE (Low Density Polyethylene) bags of 0.13 mm thickness. They were then irradiated using gamma ray with doses of 5 and 10 kGy, respectively. Parts of samples were directly analyzed and the rest were stored for six months at room temperature of 29 $\pm$ 2 °C and 70 % to 95 % humidity. The results of the studies showed that total bacteria count of four kinds of investigated samples before irradiation were found to be in the range of 10^6 – 10^9 counts/g, whereas moulds were found to be 10^3 – 10^6 counts/g. Irradiation with doses less than 10 kGy could reduce the microbial load of dried rhizome of these samples by 2 – 4 log cycles for the total plate counts, and -1-3 log cycles for the total

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mould. The effect of six months storage could decrease the number bacteria and mould in irradiated sample but not in the un-irradiated one (5, 8).

SPROUTING INHIBITION OF FRESH RHIZOME

Gamma irradiation for sprouting inhibition of fresh harvested rhizomes namely *C. xanthorrhiza* Roxb, *C. aeruginosa*, *K. galanga* and *C. domestica* has been studied to extend their shelf life. The fresh rhizome samples were packed in plastic net bag then irradiated at room temperature with doses of 0.06; 0.08; 0.10; 0.20 and 0.25 kGy. Post irradiation storage was at room temperature of 29 $\pm$ 2 °C and humidity ranging from 85 to 95 %. Results showed that irradiation doses of 0.06 – 0.08 kGy was sufficient to inhibit sprouting of fresh harvested rhizomes and prolonged its storage life for 6 – 8 weeks. In un-irradiated fresh rhizomes sprouting were found within 1 – 3 weeks after harvesting (9).

PHYSICO – CHEMICAL CHARACTERISTICS

Physico-chemical characteristics study on Zingiberaceae namely *C. xanthorrhiza* Roxb, *C. aeruginosa*, *K. galanga* and *C. domestica* were done using gamma irradiation at doses of 0.25 kGy (sprouting inhibition dose) and 10 kGy (pasteurization dose). Studies were carried out to support the application of irradiation on radio pasteurization of raw materials and herbal medicine and sprouting inhibition of fresh rhizome herbal plants. The research was conducted to investigate the effects of gamma irradiation at a dose of 10 kGy by studying the content and characteristics of the essential oils from the four samples. The sliced tubers, with 8 to 14 % of moisture content, were packed in LDPE plastic bags with 0.13 mm thickness, and then were irradiated with doses of 5 and 10 kGy. The results showed that the content and characteristics of essential oils from the samples analyzed using Gas Liquid Chromatography (GLC) and High Performance Liquid Chromatography (HPLC) were not affected (8). Gamma irradiation dose up to 0.25 kGy on fresh rhizome did not give significant effect on the content and characteristics of essential oils (9).

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Curcumin is the main component of temu-lawak and turmeric. The effects of gamma irradiation on curcumin component of *C. domestica* rhizome were also investigated. Pure curcumin, sliced and powdered turmeric rhizome with 10 % of moisture content was analyzed using HPLC and Electron Spin Resonance (ESR) spectrometer. The results showed that free radicals were already present in un-irradiated controlled samples. Gamma irradiation at doses of 10, 30 and 50 kGy induce free radicals formation on both turmeric rhizome and pure curcumin. The percentage of free radicals intensity in irradiated turmeric was decayed during storage. However, free radicals were very stable in irradiated pure curcumin. Irradiation treatment up to a dose of 10 kGy and storage time up to 3 months did not give significant change on curcumin content, water activity, pH and moisture content of turmeric (*C. domestica*) (10). Studies were also done to determine the essential oil and curcuminoid characteristics, which was extracted from irradiated temu-lawak (*C. xanthorrhiza* Roxb). The observed parameters were the characteristics of essential oil and curcuminoid analyzed using HPLC, GLC, and FTIR (Fourier Transform Infrared). At the same time, the essential oil and curcuminoid were also examined for the antimicrobial activity on the growth of *Aspergillus flavus* on Potato Detroxe Agar (PDA). The result showed that spectra of characteristic of essential oil and curcuminoid analyzed by HPLC, GLC, and FTIR spectrometer had no significant change by gamma irradiation up to a dose of 30 kGy (11).

LEGAL STATUS AND COMMERCIAL APPLICATION

The status of legislation on irradiated medicinal plants and herbal medicines has been released by the National Health Authorities in Indonesia, allowing the use of gamma irradiation for sprouting inhibition at a maximum dose of 0.15 kGy and gamma irradiation dose clearance to reduce microbial contamination at a maximum dose of 10 kGy. (Decree of Health Ministry No. 152/MENKES/SK/II/1995 dated 10 February 1995) (12).

The Centre for Application of Isotopes and Radiation Technology – National Nuclear Energy Agency (CAIRT – NNEA) has been able to transfer the gamma

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irradiation technology for radio sterilization and radio pasteurization technique to a private company, which is a good progress for application of this technology in medicinal plant, herbal medicine, pharmaceutical, and cosmetic industries. Currently some factories have been using the radiation-processing technology commercially in order to reduce pathogenic bacteria and mould contamination of raw materials and herbal medicines as well as to sprout inhibition of fresh rhizome.

FUTURE PROSPECTS

There are more than 30.000 species of plants growing in Indonesia. Moreover, about 1.000 species including zingiberaceae has been recognized to have medical potentials (1, 13). Currently the numbers of herbal medicine industries are also increasing rapidly to supplies the domestic market and export commodities. The application of radiation processing in Indonesia is becoming very important; it touches not only on the quality of raw materials and its products, but also on the well-being of the people. The rapid development of herbal medicine industries in Indonesia requires technologies which can offer high quality product, high efficiencies and it is environmentally friendly. Radiation processing technology in many ways meets these requirements.

CONCLUSION

Studies done at The Centre for The Application of Isotopes and Radiation, BATAN, on the subject of Gamma Radiation Processing on Temulawak (*Curcuma xanthorrhiza* Roxb) and other *Zingiberaceae* has shown the following benefits from the view point of microbiological and chemical aspects. The use of gamma radiation processing as pasteurization technique and for sprouting inhibition of temulawak (*Curcuma xanthorrhiza* Roxb), temu hitam (*Curcuma aeruginosa*), turmeric (*Curcuma domestica*) and galanga (*Kaemferia galanga*) is potential and beneficial since non chemical residue occur, processed at room temperature, high penetration, final-package processing and environmental friendly. Therefore pharmaceutical, medicinal herbs

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(*jamu*) and cosmetics industries are able to utilize the gamma radiation as pasteurization and sprouting inhibition technique due to the availability of radiation facility and the issued regulation from the Department of Health.

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