BIODEGRADABILITY OF GAMMA-IRRADIATED WOOD AND ITS APPLICABILITY TO THE TERMITE MANAGEMENT

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There were no remarkable changes/modifications of the cell wall surfaces of spruce, beech and popular based on the early microscopic observations (1), when they were gamma-irradiated at 500 kGy. The similar results were reported on the gamma-irradiated pine wood (2). Since lignin is more stable than cellulose in the wood cell wall against gamma irradiation, the former is degraded little even at the dose of gamma irradiation which causes degradation of wood cellulose (3). High doses of gamma irradiation decrease the degree of polymerization of cellulose (4), resulting in the changes of physical and mechanical properties. These reports suggest that a drastic change of wood cell wall is induced by gamma irradiation the range between 100 kGy and 1 MGy.

Although lignin remains intact and the degree of polymerization of cellulose decreases at low gamma-irradiation (4), the decay resistance of white oak, red oak, sweetgum and Douglas-fir against a brown-rot fungus, *Poria monticola* did not go down (5). Unfortunately, there has been no information about termite resistance of the gamma-irradiated wood. As the strength of cellulose material is related to the DP of the cellulose (6), gamma-irradiated wood is easily bitten and taken by termites due to the relatively lower DP of cellulose. If gamma irradiation helps termites eat more wood, the gamma-irradiated wood might be suitable for the substrate of bait toxicant in the termite management system, because an ideal substrate is highly resistant to microbial infection (decay and sapstaining fungi and molds) and vulnerable to termites at the same time. Since some microbial infection obviously discourages the termite to gain an access to bait stations and in contrast, low termite resistance is likely to attract termites.

The gamma-irradiated *Cryptomeria japonica* sapwood was tested for its biological resistance and potential as the substrate of toxicants in termite bait system. Laboratory evaluations clearly showed that the decay resistance of *C. japonica* sapwood did not change after gamma irradiation due to the unchanged matrix of cell wall. On the other hand, a decreased degree of polymerization of cellulose by gamma irradiation resulted in the raised feeding activity of the subterranean termite, *Coptotermes formosanus* in the no-choice laboratory test. This discovery that gamma irradiation of wood enhanced termite feeding definitely insisted on the necessity of further research to discuss the applicability of gamma-irradiated wood to the bait substrate in termite management program.

Additional laboratory evidences indicated the superiority of the gamma-irradiated wood as the bait substrate to nondurable and moderately durable timbers such as heartwood of *Pseudotsuga menziesii*, *Larix kaempferi* and *Chamaecyparis obtusa* in both no-choice and comparative choice tests using termites from multiple colonies. Although the variation of termite feeding activity and survival rates among test termite colonies had been anticipated, the experimentation did not show any conspicuous effect of termite colonies. Both no-choice and multi-choice tests always indicated that *C. japonica* sapwood gamma-irradiated at 200 kGy always outperformed any other wood species tested.

The gamma-irradiated *C. japonica* was finally examined for its potential as the bait substrate (matrix) for termite management. Noviflumuron or hexaflumuron, insect growth regulators (IGRs), was impregnated into the gamma-irradiated wood, and *C. formosanus* workers were forced to eat the treated wood blocks. The termite workers were then fed on untreated filter paper to record the number of dead termites with time. The gamma irradiation favorably helped termites eat more wood with noviflumuron or hexaflumuron in. The results of this bioassay clearly demonstrated that both IGRs did not lose their slow-acting and low dose-dependent characteristics required as the bait toxicant.

All these results strongly support that gamma-irradiation at 200 kGy is feasible in converting nondurable wood into more suitable substrate of bait toxicants, and that further studies should be planned to demonstrate the usefulness of gamma-irradiated wood in the field where alternative food source is always available. The gamma-irradiated wood should be examined in terms of its attracting and/or arresting ability as well under the field conditions to establish environmentally benign termite management as a result of the commercialization of gamma irradiation technology.

REFERENCES
[1] Polčin, V. J. and Karhánek M. (1964) Holzforschung 18: 102-108
[2] Burmester, A. (1966) Materialprüf 8: 205-211
[3] Seifert, K. (1964) Holz Roh Werkst 22: 267-275
[4] Siau, J. F, Meyer J. A. and Skaar C. (1965) For Prod J 15: 162-166
[5] Scheffer, T. C. (1963) For Prod J 13: 208
[6] Teszler, O., Kiser L. H., Campbell P. W. and Rutherford H. A. (1958) Text Res J 27: 456-462