CURRENT STATUS OF IRRADIATION FOR USE IN INSECT CONTROL

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At the 1974 meeting of this group I reported that the reasons why ionizing radiation had not been adopted generally for control of stored-product insects appeared to be wholly economic (1). Although some engineering studies had indicated that on a per ton basis radiation disinfestation had a favorable cost relationship to fumigation, these studies were based on the assumption that all the product handled by a facility would be treated and that the product would be continuously and uniformly available for treatment. In fact, neither of these assumptions is correct. Fumigation of commodities is usually done only when necessary, and the amount of most products that move through collection or shipping points fluctuates greatly. In addition, the initial cost of an irradiator is high, which means that most of the cost for several years of disinfestation would have to be paid at the beginning of the operation.

Even if these cost factors could be overcome, there would be (and has been) considerable delay in the legal acceptance of food irradiation. The national health agencies in many countries have ruled that irradiation constitutes a food additive and therefore is subject to evaluation by long-term animal feeding studies. Further, radiation is considered a different additive to each food, so proven safety with wheat, for example, does not give automatic clearance to any other cereal grain or even to processed wheat products. This is true even though very low levels of radiation are necessary for the insect disinfestation compared with the levels needed for bacterial pasteurization of seafood or chicken (200 krad and up) and the much higher doses (in the Mrad range) necessary for complete microbial sterilization of beef and other meats. Just how time consuming and expensive a procedure is involved is shown by the U. S. Army's program of wholesomeness testing of radappertized beef: it has required 5 years and $5 million (2).

In an attempt to satisfy the extensive testing now required by health authorities and to stay within national budget limitations, 23 countries joined with the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture in the International Program in the Field of Food Irradiation (IFIP). The group has its headquarters at the Federal Research Center for Nutrition, Karlsruhe, Federal Republic of Germany. IFIP has conducted extensive tests of several foodstuffs for wholesomeness for human consumption. Largely as a result of the data produced, the Joint FAO/IAEA/WHO

Expert Committee at its meeting in 1976 recommended clearances on several foodstuffs (3). The stored products that have been cleared for insect disinfestation are listed in Table 1.

Table 1. World Health Organization (FAO/IAEA/WHO Expert Committee) clearances for insect disinfestation.

Product	Type and source of radiation			Dose	Date of
	^{60}Co	^{137}Cs	10 mev max. electrons	(krad)	approval
Papaya	x	x	x	50-100	7 September 1976
Wheat and ground wheat products*	x	x	x	75 max	12 April 1969
Wheat and ground wheat products**	x	x	x	15-100	7 September 1976
Rice***	x	x	x	10-100	7 September 1976

* Temporary acceptance.

** Unlimited clearance (unconditional acceptance: WHO).

*** Provisional.

Also, the Codex Committee on Food Additives of the Codex Alimentarius Commission, which had included the irradiation process within its terms of reference in 1969, adopted, at its 1977 meeting a Draft Standard on Irradiated Food and a Code of Practice for the Operation of Radiation Facilities Used in the Treatment of Foods. The Joint FAO/IAEA/WHO Expert Committee submitted these drafts to the Codex Commission at Step 5 of the Codex Procedure. The Codex Alimentarius Commission meeting in Rome, Italy, 17-18 April, 1978, decided to advance the Draft Standard and the Code of Practices from Step 5 to Step 6. This enabled the Codex Secretariat to submit the Standard and the Code of Practice to all 116 member countries of the Codex for comments and to plan to evaluate these comments at the next session of the Codex Committee on Food Additives (October, 1978) with a view to elevating the proposals to the next step in the Codex Procedure (4). This is probably one of the most important advances made in food irradiation in several years.

However, at the present time, IFIP is scheduled for termination in 1980. Unless there is a fundamental change in the evaluation of wholesomeness of irradiated foods by that time, the participating countries may lose interest (2).

Finally, active research programs on stored-product disinfestation are underway in a number of countries and at a number of institutions in some countries. There are also several international programs having to do with food irradiation, some of which include research on stored-product disinfestation. In addition, the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture oversees several coordinated research programs on various phases of food irradiation. Some of these programs deal specifically with stored-product disinfestation, and most of them involve one or more of the cereal grains and pulses. However, some programs involve disinfestation of products such as dried fish in the Philippines, Indonesia, and Bangladesh (5); dried dates in Iraq; cocoa beans in The Netherlands and Ghana; and coffee beans in Brazil (6).

It is thus easy to think and say that the reason for the current lack of practical use of radiation in food processing is the difficulty in obtaining clearances from health agencies and the nonuniformity of regulations between countries, but this is only part of the difficulty. For example, in the U.S.S.R. irradiation of grain at 30 krad has been permitted since 1959, and irradiation of dried fruits at 100 krad and dried food concentrates at 70 krad has been permitted since 1966. In the U.S.A., regulations have permitted irradiation of wheat and wheat flour since 1963. Canada has permitted irradiation of wheat and whole wheat flour at 75 krad since 1969, and Bulgaria has permitted grain irradiation at 30 krad and irradiation of dry food concentrates and dried fruits at 100 krad since 1972 (3). Nevertheless, no large-scale use has been made of the process. The primary reason why radiation is not being used is therefore still economic.

It is because of the importance of economic considerations to the acceptance of radiation in food processing that recent developments in the cost and operation of accelerators are so noteworthy. One firm in the U.S.A. now claims to be able to provide an electron accelerator that will treat grain with a dose in the 50 krad range for about \$0.118 to \$0.20 U.S.dollars/metric tonne. This figure is predicated on a flow rate of about 400 metric tonnes/hour; with an increased flow rate, the cost per unit treated would decrease (7).

At least two electron accelerators for grain irradiation are being built or are in the process of being built. The Instituto de Fisica, Univerisidad Nacional Antonoma de Mexico and the Programa de Technologia, Instituto Nacional de Energia Nuclear are jointly building an irradiator for maize irradiation. This facility will make use of a rebuilt Dynamitron(R) accelerator. Maize will move through the radiation field in an airstream. This unit, while not of a commercial size, will treat sufficient maize so consumer acceptance data can be evaluated and will provide reliable cost estimates (8). Also, there are plans to build an electron irradiator for grain irradiation at the Port of Odessa, U.S.S.R. (9).

Several additional factors may interact to give added impetus to the adoption of ionizing radiation disinfestation of grain and other stored products. For example, the increasing problem of insecticide resistance, the problem of chemical contaminants, and the difficulty of fumigation at export may all contribute. However, the increasing demand by buyers for insect-free products probably will be the major reason for adopting such new and more effective insect control methods. This demand is certain to be increased with the new generation of insect detection devices that are about to be marketed.

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