Food Irradiation: Contributions to Public Health in Developing Countries

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In any discussion of food irradiation and its contributions to public health in developing countries, there are a number of factors which have an interaction. Two elements which dominate the analysis are poverty and population. It is not necessary for me to dwell at any great length the impact these two factors have except to say that the consequences are widely applicable to large population groups in many areas of the world which fall under the term "developing countries". By poverty, I mean, inadequacy among individuals to fully "demand" their needs.

Demographers have a theory of "demographic transition" which suggests that, accompanying technological progress, the rate of natural increase in population of any country passes through three phases. Phase 1 represents the period when both death rate and birth rate are very high, leading to a slow natural growth of population. In Phase 2, death rate declines, thus increasing the average life expectancy but birth rate stays high to very high which results in an acceleration of population growth. In Phase 3, birth rate declines dramatically and the rate of natural growth stabilizes at around 1 per cent per annum.

This concept of "demographic transition" seems to have been fulfilled. However this theory does not indicate the rate of change in technological progress or the time scale over which this change must be achieved for these transitions from one phase to another to occur. Most developing countries are in Phase 2 of this growth curve and the population doubling time seems to be about 25 years. It is therefore relevant that these large population groups have to be provided food, shelter and a quality of life at least to levels of human survival.

Slide 1. The developing countries of Africa and Asia have the lowest availability of protein and calories. With the recent recognition that human daily requirements of protein may be less than those estimated earlier and the consequent scaling down of these figures by international agencies, total food deficit assumed greater importance. It has been shown that if enough food (calories) is supplied, the protein gap if any, vanishes.

It may be seen that with advent of the green revolution, the per capita availability of food has shown an increase during the past decade, although population increase during the period has been significant. Currently, the gap between estimated requirement and availability is small and gives the hope that the country can be self-sufficient in the near future.

The national averages often do not tell the full story as economic factors lead to uneven distribution of total food supplies. The shortages are more severely felt by the poorer segments as they are economically unable to demand their full share; thus, economically weaker sections of most developing nations live in a chronic state of near famine **(Slide 2)**.

GLOBAL AVAILABILITY OF FOOD PROTEIN AND ENERGY (1971)

Region	Available protein g per caput per day	Available food energy Cal. per caput per day	per cent of requirement
Developing countries	**57,4**	**2200**	**95**
Africa	58,4	2190	94
Far East	50,7	2080	94
Latin America	65,0	2530	105
Near East	69,3	2500	102
Developed countries	**96,4**	**3150**	**123**
World	**69,0**	**2480**	**104**

Slide 1

TRENDS IN AVAILABILITY AND NEEDS OF FOOD ENERGY IN INDIA

	Food energy per caput per day Cals.	Remarks
Availability in 1965	1958	The gap between available resources and estimated needs, on national average basis, is marginal (around 5-8%)
" in 1970	1992	
" in 1975	~2100	
Estimated requirement	2210	
ICMR recommendation (for adults)	2400	

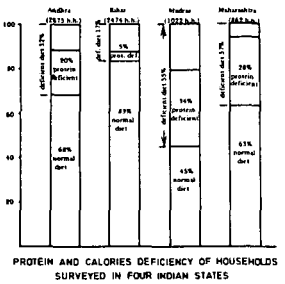
Slide 2

Slide 3. The existence of calorie and protein deficiences in several thousand households in four different states of India is shown. These figures clearly bring out the fact that the extent and severity of dietary inadequacies among individuals or families are masked by average food availability figures, especially when economic disparities are rather high in the population. The basic and most important public health problems facing the countries of the developing world, therefore, is a small insufficiency of food resources and an apparently large inadequacy in vulnerable sections of the populations to purchase food.

The food needs of the population have often to be met by developing nations through import from surplus countries.

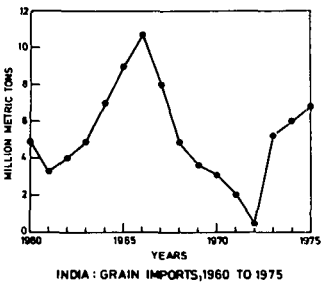
In the case of India, such imports of food grains have been marginal during the past decade, when reckoned in terms of the country's production. Thus, as against the current production of around 118 million tonnes, the imports have ranged between less than 0.5 to a maximum of around 10.0 million tonnes a decade ago **(Slide 4)**.

It is an unfortunate paradox that even with this limited availability of food, considerable quantities of the food that is grown are lost as a consequence of adverse climatic conditions and the lack of effective methods of conservation.



PROTEIN AND CALORIES DEFICIENCY OF HOUSEHOLDS SURVEYED IN FOUR INDIAN STATES

Slide 3



INDIA : GRAIN IMPORTS, 1960 TO 1975

Slide 4

Grain losses still colossal

You Said It

Bumper crop poses storage problem

FCI facing storage problem

Slide 5

ENERGY INPUTS INTO THE FOOD SYSTEM IN THE UNITED STATES

Phase of food production	Energy expenditure ($\times 10^{-12}$ k cals)	
	1960	1970
on the farm	374 (26%)	526 (24%)
Post-harvest technology	1066 (74%)	1646 (76%)
Food on the table	1440 (100%)	2172 (100%)

Slide 6

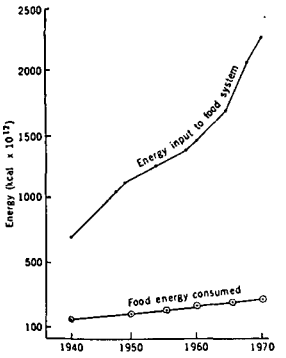
The recent spurt in agricultural production has served to emphasize the inadequacy of the storage facilities (Slide 5). Advances in the agricultural sector will have to be geared up to the development of adequate post-harvest technological measures to ensure the accrual of maximum benefits. In India, the loss of cereal grains, the major staple food, during storage, is estimated to be around one tenth of production. The full significance of this loss can be realized by comparing it with the figures of food grain imports shown earlier. If the losses can be significantly minimized, even if not totally eliminated, the country could have avoided the import of grains during the past decade, which has been a major drain on our foreign exchange reserves. To give you a feel for figures, in an effort to hold a buffer stock of food grains, the Government of India spent around $2700 million dollars to buy 18 million tonnes of food grains. The most conservative estimate of losses of food grains have been of the order of 10% of this produce or around 10—11 million tonnes costing over $2000 million dollars.

From the foregoing, it is amply evident that an easy, short-term, practical step toward bridging the marginal gap between availability of food and the needs of the population would be through effective conservation of all that is produced.

And as a bonus the money saved could be deployed for betterment of living standards of the rural section of the population and towards a positive public health programme.

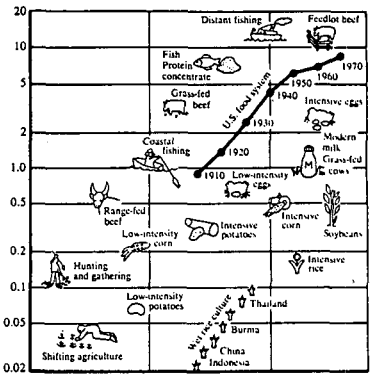
Although there are extensive well-developed technologies that are successfully employed in the industrialized countries for processing and preservation of foods, there are severe limitations to their 'in toto' transfer to most developing countries. These contraints arise from inadequacy of various national resources like finance, materials, the needed technological infrastructure and, above all, energy. The entire food system in the developed countries is energy intensive.

The food industry in the USA, for example, accounts for over one-eight of the total energy utilized and, as may be seen from the data, three times as much energy is expended on post-harvest technology as on production in the farm (Slide 6).



Energy use in the food system, 1940 through 1970, compared to the caloric content of food consumed.

Slide 7



Slide 8

Looking at it from another angle, over the years of technological development, it has become necessary to put in greater and greater quantities of energy for obtaining a unit amount of food energy. This is primarily because economic considerations of food production and processing in the industrialized countries in the past have been oblivious of energy inputs during the era of abundant and inexpensive fossil fuel availability **(Slide 7)**.

Such high energy food systems require inputs of energy that are greater by an order of magnitude than those in the less developed countries for providing an equivalent amount of food even at the farm level **(Slide 8)**.

The developing countries of the world cannot afford to apportion large quantities of their meagre energy resources for food preservation. Additionally, high inputs of energy and the consequential increment in the cost of the produce can only aggravate the imbalance in distribution between different economic segments. These considerations emphasize the need for the adoption of technologies for food preservation that entail minimum energy requirements. It is in this context that developing nations should make an objective assessment of the distinct advantages that radiation preservation offers over other commercial methods. It enables the realization of the basic objective, viz., extension of shelf life of various produce in the 'as is' condition, with minimal processing, unlike the majority of other methods.

Realizing the potentials of the process, the technology has been studied in detail in India for over a decade for specific applications involving major crops of economic and nutritional significance to the country. These studies have helped to define processing parameters for disinfestation of wheat, sprout inhibition of potatoes and onions, extension in shelf life of sea-foods and delaying the ripening of banana and mangoes **(Slide 9)**.

Notwithstanding the recent thinking that provision of enough food (energy) will in itself abolish the deficiency of protein in the diet, the nutritional importance of increasing the animal protein content of diet in the poorer countries is recognized. The only practical source of animal protein that could be tapped to provide significant quantities to vast populations would appear to be the sea-foods. Most developing nations with a coast line are turning their attention to the exploitation of the fishery potential of the seas around them.

POTENTIALS FOR FOOD IRRADIATION APPLICATIONS IN INDIA

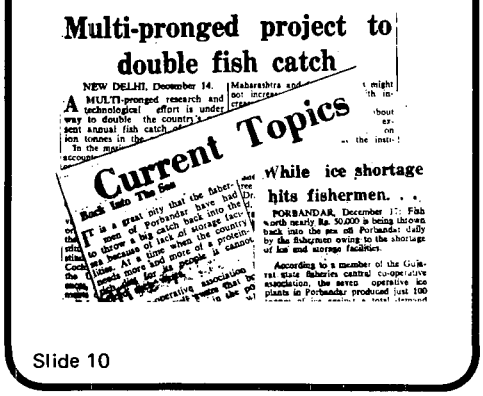
Produce	Annual output (x 10^6 tonnes)	Economic/Nutritional significance
Wheat	25–30	Major cereal (>25%); elimination of loss during storage can help quantitative improvement of food availability
Potatoes	5,0	Important inexpensive source of energy to bridge the calorie gap
Sea-foods	1,5	Only source of animal protein that can be made available on a significant scale; quantitative improvement of food.
Mangoes, Bananas	6,0	Minimising spoilage loss will increase availability of these 'protective foods'. Increased export earnings and consequent economic betterment of producers.
Onions	1,5	Increased export earnings and consequent economic betterment of producers

Slide 9

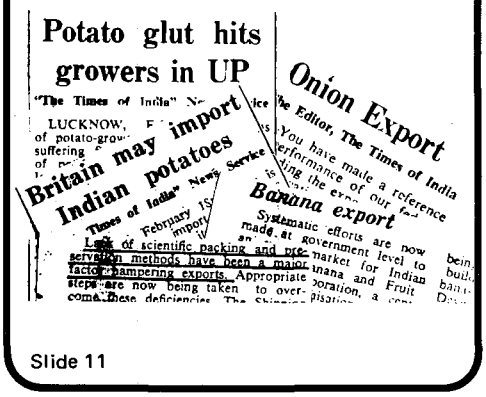
Slide 10 brings out the paradoxical situation created by the attempts on the one hand to increase catch and the lack of effective preservation methods on the other. A major constraint in expanding fishery operations is that the highly perishable nature of the sea-foods does not permit its transport to markets in the hinterland. Irradiation could provide the critical extension of the shelf life of sea-foods that is necessary for the purpose, the internal demand created thereby, in turn stimulating increased fishing.

Slide 11 depicting newspaper reports of various surplus produce and the scope for their exports also refers to the need for scientific methods of preservation that will enable the perishables to withstand the long sea journeys.

A major reason for the tardy progress in the commercialization of food irradiation on a global basis is the extreme caution with which public health authorities tend to view the safety of irradiated foods. The large volume of evidence that has been gathered to date on irradiated foods, both at the national and international levels, is a unique record of nutritional and toxicological assessment of any chemical, let alone a processed food.



Slide 10



Slide 11

Although no unequivocal experimental evidence has turned up to indicate health hazard in consumption of irradiated food, public health authorities in some countries continue to view then with undue suspicion. It is an irony that the countries which most need to adopt methods to prevent food losses seem to be in this group. Out of the 17 or so countries which have cleared one or more irradiated food item for human consumption, there is only one country from the developing region.

I would like to remind my friends involved in public health matters – "In whatever we do and in whatever we refrain from doing we are accepting a risk". Some risks are obvious – deaths from starvation and the physical and mental underdevelopment from malnutrition are indeed staggering, some risks are unsuspected and some we conceal from ourselves. But risks are universally accepted. Even with chemicals and pesticides which are suspected as mutagens but have acknowledged usefulness, the benefit-risk calculations have demonstrated a high benefit to risk ratio when a correction factor for special economic, social or medical situation of developing countries is taken into account.

It should be reassuring to all of you that a recently concluded meeting of the WHO/FAO/IAEA expert committee has recommended "unconditional acceptance" of wheat and potatoes and certain additional items for human consumption.

To conclude, let me state that there is a need to capitalize on the opportunities that are already at hand in attempts to solve the problems of food loss. It would be unwise to continue to sit back and watch the insects and the micro-organisms eat the food produced by sweat and toil of thousands of people. We have vast numbers of hungry people waiting for an adequate diet and a better quality of life. Let us not be obssesed by a "perfection in research". After all, we are all imperfect.