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DETECTION METHODS FOR IRRADIATED FOODS—AN OVERVIEW

HENRY DELINCÉE

Institut für Ernährungsphysiologie, Bundesforschungsanstalt für Ernährung, Engesserstr. 20, D-76131 Karlsruhe, Germany

At the workshop for Health Impact, Identification, and Dosimetry of Irradiated Foods convened by the WHO in November 1986 in Munich, it was concluded that "*in principle some methods would permit the analyst to distinguish with reasonable certainty between foods that have not been irradiated and those that have*". But that "*much more work is required before methods can be developed for all foods and be regarded as proven and fully acceptable for routine use*" (WHO, 1988). This lack of analytical methods to detect the irradiation treatment of foods was interpreted as a stumbling block to the introduction of food irradiation. Consumer organisations demanded that analytical detection methods should exist before clearances could be granted. Although the discussion of a real need for detection methods by analysing the food itself has been controverse, since accompanying documents could certify the radiation processing, and this processing could be well-controlled at the licensed radiation facilities, nevertheless the delegates from about 60 countries at the international conference on "The Acceptance, Control of, and Trade in Irradiated Food" recommended that "*governments should encourage research into methods of detection of irradiated foods so that administrative control of irradiated food once it leaves the facility can be supplemented by an additional means of enforcement, thus facilitating international trade and reinforcing consumer confidence in the overall system*" (Anon, 1989).

This advice has led to the establishment of two larger international programmes. One being the world-wide ADMIT programme sponsored by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, and the other one was organized by the European Community through its Bureau of Reference (BCR). It was realized by both programmes that promising methods should be subjected to collaborative testing procedures to be validated. The reports of these programmes, which now both have been terminated, are most interesting readings for anyone dealing with detection methods (ADMIT 1990, 1992, 1994; Delincée, 1991; Leonardi *et al.*, 1993; Raffi *et al.*, 1991, 1994; Stevenson and McMurray, 1995). Inter-laboratory blind trials dealing with detection of irradiated foods which were very scarcely before the step-in of the two mentioned programmes, has grown rapidly, and a total of about 30 studies are now available. Since every kind of change in an irradiated food may serve as a potential detection means, proposed methods can be divided into physical, chemical and biological methods (Delincée 1991, 1993; Glidewell *et al.*, 1993). Of the physical methods, blind trials have been carried out mainly with electron spin resonance (ESR) and thermoluminescence (TL), for the chemical methods analysis of lipid-derived products such as radiation-induced hydrocarbons and 2-alkylcyclobutanones by gas chromatography (GC) has been performed, and on the biological plain tests with germination of citrus seed embryos and microbiological tests such as the direct epifluorescent filter technique (DEFT) and the Limulus amoebocyte lysate (LAL) test in combination with viable counts have been employed.

At present, this tremendous efforts have led to the development of not only national, but also international standards. Table 1 summarizes the present existing European drafts which hopefully may be extended to world-wide standards, e.g. by ISO.

It may be expected that these European standards will come into force during 1996. These standards pertain at the moment to specific food items, which are likely to be supplemented by other food types as soon as appropriate validation by interlaboratory trials has been performed. So is the GC analysis of hydrocarbon based on blind trials on raw chicken, pork and beef but may be extended to many other fatty foodstuffs. So have laboratory intercomparisons already taken place on mango, papaya, avocado and camembert. The GC/MS determination of 2-alkylcyclobutanones has been tested in collaborative studies on raw chicken, pork and liquid whole egg, but may equally be extended to other fat-containing foods. The ESR method on bone has been validated for chicken, froglegs, pork and trout, and it is assumed that the same signals occur when other animal species including fish are analysed. ESR spectroscopy of stones, shells or dry parts of food containing cellulose like berries or nuts, has been verified in blind trials with pistachio shells. A collaborative

Table 1. Draft European Standards (CEN)

prEN 1784	Foodstuffs—detection of irradiated food containing fat, gas chromatographic analysis of hydrocarbons
prEN 1785	Foodstuffs—detection of irradiated food containing fat, gas chromatographic/mass spectrometric analysis of 2-alkylcyclobutanones
prEN 1786	Foodstuffs—detection of irradiated food containing bone, method by ESR-spectroscopy
prEN 1787	Foodstuffs—detection of irradiated food containing cellulose, method by ESR-spectroscopy
prEN 1788	Foodstuffs—detection of irradiated food from which silicate minerals can be isolated, method by thermoluminescence

test with strawberries is in progress. Thermoluminescence (TL) measurements have been validated for herbs and spices contaminated with silicate minerals. Another TL trial has been successful with regard to the detection of irradiated shrimps, which contain silicate minerals in their gut. Laboratory intercomparisons with TL measurements of potatoes, fruits and vegetables are underway.

It may thus be concluded that for most food items radiation processing can now be properly controlled, and labelling can be efficiently checked. Some difficulties may arise with composite foods in which only a part has been irradiated, but also for such food components successful detection of an irradiation treatment has been described in several cases. It remains to be seen whether this tremendous analytical effort to overcome one of the main hurdles built up against food irradiation will be honoured by the consumers, so the technology of irradiating food to prevent food-borne diseases can be promoted to the benefit of public health.

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