

Food Irradiation: A Solution for the Conservation and Safety of Perishable Foods in Naval Environments by the Brazilian Navy

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1. Introduction

Approximately one-third of the global food production is lost before reaching consumers, according to data from Embrapa [1]. The United Nations (UN) emphasizes that reducing these losses is crucial for balancing food supply and demand. In this context, treatments such as food irradiation gain importance and are recognized by health surveillance authorities in 37 countries. Twenty-four of these countries already incorporate irradiation into commercial practices, highlighting its effectiveness and global acceptance.

In food preservation, irradiation has proven to be an efficient tool for significantly extending the shelf life of products, minimizing losses, ensuring food safety, and enhancing the availability of these items for consumers.

The irradiation technique plays a crucial role in eliminating or inactivating insect larvae, parasites, fungi, and bacteria present in food, thereby reducing the risk of disease transmission. Additionally, this method allows for the inhibition or delay of physiological processes such as sprouting and ripening. Given that early food deterioration is often attributed to the actions of insects, microorganisms, and degrading enzymes, irradiation emerges as an effective treatment to substantially extend the life of products [1].

Food irradiation is a fundamental technique for the preservation and pest control of food products, involving the exposure of food to controlled doses of radiation from sources such as Cobalt-60, Cesium-137, X-rays, and accelerated electrons. It is crucial to note that irradiation leaves no residues in the food and does not release radioactive materials into the environment. The entire process is rigorously monitored to ensure food quality while preserving its sensory and nutritional characteristics. A notable advantage of this technology is its post-packaging application, significantly reducing the risk of recontamination during transportation, storage, and commercialization phases [3]. In Table 1 below, concerning food irradiation, low doses are considered up to 1 kGy; medium doses range from 1 to 10 kGy, and high doses exceed 10 kGy.

Tabela 1: Doses suficientes para alcançar as finalidades almeçadas

Purpose	Absorbed Dose	Food
Sprouting Inhibition	0,03 a 0,12 kGy	Onion, garlic, potato
Ripening Delay	0,03 a 0,12 kGy	Carrot, banana, strawberry
Insect Disinfestation	0,2 a 0,8 kGy	Peach, apple, mango
Parasite Disinfestation	0,1 a 3 kGy	Oysters, shellfish, salmon
Microbial Load Reduction	1 a 5 kGy	Meat, chicken, fish
Fungal Reduction	1 a 10 kGy	Coffee, flour, corn

Source: Levy, Sordi e Villavicencio (2020)

Despite the undeniable benefits of food irradiation, research indicates that a large portion of the population has little to no information on the subject [2 – 4]. Prejudices and unfounded fears influence the risk perception among decision-makers across various segments of society, including producers, industry, commerce, and the consuming public [5]. Research also indicates a willingness to change habits and attitudes after access to information through informative actions.

This article aims to propose, based on recent studies, food irradiation as a solution for food preservation and safety in naval settings, as well as to present partial results of a survey on knowledge and acceptance of food irradiation among members of the Brazilian Navy.

2. Methodology

This work follows a qualitative descriptive research design using an electronic questionnaire as a tool for assessing the knowledge of food irradiation among the military population of the Brazilian Navy. The methodology employed in conducting this research is grounded in the works of Modanez (2012), Levy, Sordi, and Villavicencio (2018), and Juliana Gallo et al. (2022).

3. Results and Discussion

Submarine missions often involve extended periods without access to ports or external supply sources. The vessel's autonomy directly depends on its ability to maintain a sustainable food reserve for the entire crew during these prolonged operations. Ensuring the proper preservation of food becomes a strategic priority.

The effective operation of submarines, especially during long-duration and isolated missions, necessitates a careful approach to food logistics. Onboard food conservation is a critical issue directly impacting the crew's ability to maintain adequate nutritional status and, consequently, their operational performance and overall well-being.

Life aboard a submarine presents unique challenges, such as lack of natural light, constraints within confined spaces, limited fresh air supply, critical attention during combat, among others. The quality and variety of fresh foods available onboard directly impact the physical and mental health of the crew. A balanced diet is essential to sustain the physical and cognitive demands of submariners, contributing to their operational performance, resilience to adverse conditions, and

critical decision-making. To confirm these qualitative insights regarding military personnel embarking or having already embarked on Brazilian Navy ships, a survey will be conducted through an electronic questionnaire based on previous research on the irradiation of food.

In Modanez's thesis (2012), an analysis of the acceptance of irradiated foods was conducted, with a focus on education as a fundamental element in this context. The research involved the application of questionnaires to students, a systematic review of specialized literature, analysis of international research on the acceptance of irradiated foods, and verification of nuclear energy-related educational content in different countries. The thesis emphasizes the importance of integrating education about nuclear energy and its applications, such as food irradiation, into Natural Sciences, Physics, and Chemistry disciplines, aiming to promote contextualized knowledge integrated into students' lives.

The study by Levy, Sordi, and Villavicencio (2018) aimed to assess consumers' prior knowledge regarding food irradiation, highlighting the lack of information and existing misconceptions on the subject. Through a face-to-face survey with 100 participants, including educators and members of the general society, the authors identified that most associated ionizing radiation with negative aspects such as wars, contamination, and diseases. Given this scenario, the study sought to develop scientific dissemination strategies to demystify prejudices and inform consumers about the benefits and safety of food irradiation, aiming to promote public acceptance of this technology.

The research conducted by Juliana Gallo et al. (2022) aimed to evaluate the knowledge and acceptance of irradiated foods among consumers at the CEAGESP food bank, as well as investigate the effectiveness of educational interventions in disseminating the benefits of food irradiation. The survey used structured quantitative questionnaires as data collection instruments, administered to food bank employees. After the educational intervention, which included information through text, video, visual sensory analysis, and graphic material, an increase in the participants' intention to purchase irradiated foods was observed. The results indicated that information and active knowledge dissemination were effective in promoting consumer acceptance of this technology. Additionally, the study highlighted the importance of producing informative materials in Portuguese for different populations to enhance understanding and acceptance of food irradiation.

In an article also led by Levy, Sordi, and Villavicencio (2020), a comprehensive review of food irradiation in Brazil was conducted, addressing historical, regulatory, and technological aspects, as well as current challenges and future possibilities. The work analyzed legislation, norms, and resolutions related to food irradiation, highlighting the evolution of regulatory practices over decades. Additionally, the benefits of food irradiation compared to the use of agrochemicals were discussed, emphasizing the need for information and communication to promote public acceptance of this technology.

Following the line of the mentioned research, the present work proposes a virtual survey consisting of a two-part questionnaire to assess knowledge about food irradiation among the Brazilian Navy. After completing the first part of the questionnaire, respondents gain access to informative pamphlets and explanatory videos, which are expected to significantly contribute to understanding knowledge about irradiated foods. It is anticipated that, initially, many respondents may be unfamiliar with the technique, and after reviewing the provided material, there will be a positive acceptance from the surveyed audience. This work is ongoing, and partial results will be presented in the full article.

4. Conclusions

Observations from the aforementioned researches highlight the knowledge gap within the general population and underscore the importance of informative initiatives to educate various audience segments about the benefits and safety of food irradiation [2 – 5]. It is anticipated that this study will provide insight into the extent of knowledge and unawareness among the surveyed public, as well as their willingness to accept the technique after being informed. These results will guide future work, indicating the potential interest in the subject or the necessity for educational efforts to disseminate strategically significant scientific knowledge within this specific audience. Conclusions will be presented following the analysis of survey results and will be detailed in the full article.

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