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Short Communication

Irradiated ready-to-eat spinach leaves: How information influences awareness towards irradiation treatment and consumer's purchase intention

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HIGHLIGHTS

- Some uncertainty toward food irradiation was evidenced in Argentina.
- An increase in acceptance by 90% was found after providing informative material.
- Roughly 40% of respondents were willing to consume/purchase irradiated spinach.
- About 35% of the respondents did not exclude to accept irradiated spinach.
- Irradiated spinach could be introduced in Argentina if consumers were better informed.

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ABSTRACT

This article aims to clarify and supply further information on food irradiation acceptance, with particular focus on Argentina and irradiated ready-to-eat (RTE) spinach leaves through an open web-online survey. Results showed that half of respondents did not know food irradiation, but the other half demonstrated uncertainty despite they declared they had knowledge about it; thus, confirming little awareness towards this technology. Respondents who believed in the misleading myth about food irradiation represented 39%, while roughly the same number was doubtful. On the other hand, after supplying informative material, respondents were positively influenced and an increase in acceptance by 90% was found. Finally, 42% of respondents were willing to consume/purchase irradiated RTE spinach leaves, and 35% remained doubtful. Respondents who did not exclude to accept irradiated spinach could be considered potential consumers if intensive campaigns about the benefits of food irradiation were carried out by reliable actors. If the Argentinean RTE market grew, following the world consumption trend towards these products, irradiated spinach leaves could be successfully introduced by making better efforts to inform consumers about food irradiation.

1. Introduction

Food irradiation, as a processing technology, offers significant consumer advantages especially in food safety (Bruhn, 1998). The latter has driven studies in the fields of food science and consumer research during the last decades (Behrens et al., 2009). Food irradiation is approved in more than 50 countries (Eustice and Bruhn, 2013) and there are roughly 30 countries which have facilities for this purpose (Roberts, 2014). Eustice and Bruhn (2013) presented a list of organizations that approve or endorse food irradiation, among them the World Health Organization (WHO).

During recent decades, the industry of ready-to-eat (RTE) vegetables has grown exponentially worldwide. Nevertheless, RTE vegetables market in Argentina is still being developed and their products are mostly demanded in highly populated cities where time for preparing and cooking food is being continuously reduced. Safety in RTE vegetables is of great concern and leafy greens have been pointed out as the products most frequently implicated in outbreaks (Santos et al., 2012). As a consequence,

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irradiation, which is a well-known treatment for extending food's shelf life, has been studied as a non-thermal strategy for extending shelf life and decreasing postharvest losses of fresh vegetables by Fan et al. (2012, 2008), among others. Furthermore, irradiation applied on several vegetables can effectively control typical pathogens associated with these products, even those microorganisms internalized into vegetal tissues (Niemira, 2007).

Despite the facts that irradiation satisfies economical and food safety issues, many people are still unfamiliar with this technology. Furthermore, misleading concepts about food irradiation have been proposed despite it was recognized as a safe technology. Many authors have identified lack of knowledge by consumers as the main factor that determines consumer preference for other technologies. Cardello et al. (2007) pointed out that the perceived potential risks are the critical determinants of the market success of food irradiation; nevertheless, the food industry's willingness for propagating radiation processing and offering irradiated foodstuffs on the market-place might play an important role as well. Market research has been carried out over the past two decades, and it was demonstrated that 80–90% of potential consumers preferred irradiated foodstuffs over non-irradiated after they were informed about the benefits that come along with the irradiation processing (Eustice and Bruhn, 2013). Nevertheless, it is well known that cultural and demographic factors can influence consumer attitudes towards irradiation; hence each population needs to be investigated separately.

In Argentina there are two irradiation facilities, one operating since 1970 (Centro Atómico Ezeiza, CAE) and the other since 1989 (Ionics Inc.); however, few irradiated foodstuffs are available in stores and markets. Furthermore, only two studies in consumer research field related to food irradiation were published in last years. Urioste et al. (1990) investigated how positive information about the technology affected consumer purchase intention of irradiated onion. The second, more recent, is that performed by Flores and Hough (2008), who evaluated how purchase intention of irradiated foodstuffs, without focus in specific products, was influenced by several factors (type of information provided, educational level of respondents, and city of residence).

This article aimed to clarify and supply further information on food irradiation acceptance, with particular focus on Argentina and irradiated spinach leaves as a ready-to-eat product, by researching the following questions through an open web-online-survey:

- Are people in Argentina aware of food irradiation?
- Do the respondents believe in the statement which expresses that irradiated foodstuffs can be harmful to consumers' health?
- How positive informative material affects consumers' awareness and purchase intention?

2. Materials and methods

2.1. Procedure

A web-online-survey was conducted during May 2015. Respondents were indistinctly contacted through mobile phone messages, email, professional networks (LinkedIn), and social networks (Facebook and Twitter). To avoid biased results, the investigation was done without any previous explanation about food irradiation. The questionnaire (shown in Section 2.2) started with mandatory questions that allow only people living in Argentina and aged more than 18 years old to fully complete the survey. Next, general information (age, sex and education level) and some information about consumers' preference and behavior were required. Finally, questions about whether or not food irradiation is safe and intention to buy irradiated foodstuffs were asked before and after providing informative material (shown in Section 2.3). The minimum required sample size was set at 384 (95% confidence level and 5% margin of error) and it was established according to Krejcie and Morgan (1970) (see also table reported by KENPRO (2012)). Surveys which were not completely answered were discarded, 4.6%, and data from 416 completed questionnaires were analyzed.

2.2. Questionnaire

Q1- Are you 18 years old or older?
Q2- Do you live in Argentina?
Q3- How old are you? Choose a range
Q4- Which is your sex?
Q5- Please indicate your maximum education level achieved.
Q6- How often do you choose the foodstuffs you consume?
Q7- How often do you consume green leafy vegetables such as lettuce and rocket?
Q8- Are you a regular consumer of ready-to-eat leafy vegetables such as the one shown below? (see figure in the original questionnaire presented as Supplementary data)
Q9- Did you know that food can be irradiated for several purposes?
Q10- Have you ever consumed irradiated foodstuffs?
Q11- Would you consume an irradiated foodstuff?
Q12- Evaluate the following phrase, "Irradiated foodstuffs can be harmful to consumers' health." as true, false or don't know.
Q13- After being provided with informative material about Food Irradiation, do you feel that it is a safe technology for food processing?
Q14- Would you consume/purchase ready-to-eat spinach leaves that were subjected to an irradiation treatment?

The questionnaire on its original language (Spanish) and form can be found as Supplementary data of the present article.

2.3. Informative material

Food Irradiation

What is? It is a sort of food processing that has already been regulated and it is applied in many countries. It consists on subjecting food to ionizing radiation for a certain time under controlled conditions. *Why irradiated food?* Irradiation is an efficient preservation method since it eliminates or reduces microorganisms responsible for food deterioration and foodborne illnesses. Furthermore, irradiation can delay ripening of fruits and vegetables. *Is food irradiation safe?* Yes! When foodstuffs are irradiated they are only in contact with the emitted radiation and not with the radioactive source, thus food is not contaminated with radioactive material. *Does irradiation modify food characteristics?* Such as any other food processing method it causes some nutritional and sensorial changes. However, when irradiation doses are properly selected these changes are small or insignificant. *Source*: World Health Organization (WHO, 1999).

2.4. Data analysis

Data were analyzed and qualitative responses from questions 11, 12, 13 and 14 (Section 2.2) were converted into numbers (ratings) by coding "Yes" as 1, "No" as 0, and "Don't know/ A little/ Perhaps" as 0.5. The closer ratings' mean is to 1, respondents are either better informed about food irradiation or more willing to consume/purchase irradiated RTE spinach leaves. Next, comparisons were assessed by taking into account whether or not