STATUS REPORT FOR DEVELOPMENT OF SPACE *BULGOGI* AND OTHER KOREAN SPACE FOODS, USING IRRADIATION TECHNOLOGY

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***Abstract*-Food irradiation has been used to improve food safety and quality, by eliminating bacteria. One of the requirements for space foods is sterility because low dose of space irradiation may cause unwanted mutation of bacteria. Thus, Korea Atomic Energy Research Institute has applied irradiation technology to develop sterile space foods, and eight Korean foods were certificated by Institute of Biomedical Problems. The technology used in the development of space foods can induce ripple effects in the development of special-purposed foods such as military rations and patients' foods, which are required to be sterile for long-term storage with no refrigeration and immunocompromised patients, respectively. Development of the special-purposed foods with irradiation technology may also improve the consumer acceptance for food irradiation, which may be resulted in invigoration of irradiation industry.**

***Index Terms*-food irradiation, military rations, patients' foods, space foods.**

I. INTRODUCTION

Irradiation technology is used to produce high quality products in medical products, cosmetics, animal feeds and herbal medicines. Especially, application of this technology has been gradually increased in food industry to produce safe foods, and to extend shelf-life of foods. In addition, food irradiation was also recommended by FAO/IAEA/WHO expert committee on the wholesomeness of irradiated food (FAO/IAEA/WHO, 1999) and Codex General Standard for irradiated food (Codex, 2003). Thus, this technology can be used in 52 countries with about 250 food items. Besides decontamination efficiency, the other reason for irradiation to be used in food industry is cost effective. For instance, irradiation on fruits for disinfestations only costs 10-20% of the cost of the vapor-heat treatment (FAO/IAEA, 1999).

Space foods have been developed with various technologies for last three decades, but the previous technologies destroyed physiochemical properties of foods (Lane *et al*.1994). Thus, use of irradiation has been recommended in production of space foods because the technology destroys pathogenic and spoilage microorganisms, and also reduces enzymatic activity in the final products without compromising food quality (WHO 1999; Ahn *et al*. 2004; Yoon *et al*. 2009). Therefore, objective of this paper was to introduce status for the development of space foods in Korea.

II. DEVELOPMENT OF SPACE FOODS WITH HIGH DOSE IRRADIATION

One of the reasons to use high dose irradiation is production of sterile foods because sterile foods can be used under the condition with no refrigeration system, and the technology can prevent injured cell recovery and mutation, which could be found in low-dose irradiated foods (Horneck *et al*. 1989). In production of space foods, although heat treatment with high pressure can be used, the treatment may change physicochemical properties as well as nutrients. Hence, Korea Atomic Energy Research Institute (KAERI) used high dose irradiation to develop eight space foods such as kimchi, ramen, cinnamon drink, nutrient bar, *Bibimbob* (mixed cooked rice with vegetables and some beef), *Bulgoi* (marinated rib eye), seaweed soup, and mulberry drink. The eight Korean spaces foods have been certified for consumption in Space by Institute of Biomedical Problems in Russia, and first Korean astronaut consumed the first four space foods in International Space Station in 2008. Other reason for the development of space foods by KAERI was to provide the foods which give the Korean astronaut good appetite because previously developed space foods were usually for Russian and American space foods, which may cause loss of appetite (Song et al., 2009).

III. RIPPLE EFFECTS OF SPACE FOODS ON THE DEVELOPMENT OF SPECIAL PURPOSED FOODS

KAERI has spent a large amount of research funds and efforts to develop Korean space foods, but this technology can induce ripple effects on the development of military rations as well as patients' foods. The military rations should have light weight, high calories, long-term storage period, and high quality nutrients, which can be obtained by food irradiation as used in the development of space foods. Moreover, military rations can be directly used for the foods for outdoor activities and emergency foods because of same required properties as military rations. This may be resulted in invigoration of irradiation industry.

Unlike the reason to irradiation for other special purposed foods, irradiation technology is used to lower viscosity of patients' foods, because most patients are challenged to chew and swallow their foods. Thus, low viscosity is an indispensable property for patients' foods, but carbohydrate in foods has lower calories as viscosity decreased. However, irradiation on carbohydrate breaks down carbohydrate chains which lower viscosity in foods, and more amount of the broken carbohydrate molecules can be contained in foods compared to intact carbohydrate, resulting in prevention of calory decrease.

IV. SAFETY ISSUES OF HIGH DOSE IRRADIATED FOODS

Safety concerns for irradiated foods always have been issued for many years, but distinguished international agencies such as International Atomic Energy Agency, World Health Organization, and Food and Agriculture Organization have conducted many researched to prove the safety of irradiated foods. In addition, many studies showed that irradiation on foods is toxicologically safe and nutrients were not changed (USFDA, 1997; Mazur, 2003). Interestingly, steele (2001) suggested that criticism about irradiation is originated from incorrect information.

Since the safety issues would influence consumer acceptance for irradiated foods, the development of special-purposed foods such as space foods, military rations, patients' foods, foods for outdoor sports, and emergency foods may bring consumers' attention for irradiated foods, which clear consumers' misunderstanding to irradiated foods.

V. CONCLUSION

Use of irradiation to develop space foods may ensure safety and security of the foods, and the technologies used for space foods can be transferred to develop other special-purposed foods, and it may improve consumers' acceptance for irradiated foods.

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