

## Lipidomics demonstrated quality chagement of chilled beef loins irradiated by electronic eradiating accelerator

Jie Zhang

### Abstract

Irradiation is an important cold sterilization technique, and has been approved in the application of food field including spice, dehydrated vegetables, frozen meat and cooked meat products. However, it has been limited in the food high in fat since irradiation could induce the off-odor because of fats oxidation. With the development of high-energy electronic eradiating accelerator, it could keep the sterilization effect and inhibit the fats oxidation when compared to the conventional  $\gamma$  rays irradiation, especially with irradiation from the high dose rate. In the previous paper, we firstly screen effects from dose and dose rate on the physical form of irradiated chilled beef loins. In the present paper, we further investigated the lipidomics variation between control and treated by 3.0 kGy in 150 kGy/min. The results showed that there were 857 lipid compounds found in the irradiated chilled beef, which belong to sterol, fatty acids, glyceride, sphingolipid, PA, PE, PG, PS, PI and CL. There were huge differences between composition and species variation; and PC decreased by 3%, fatty acids 4%, glyceride 6%, and PE 1%. The lipidomics analysis provided the important evidence for the lipid quality chagements.

Color is a primary factor used by consumers to judge beef quality, especially freshness. Recent studies indicate that dietary supplementation of vitamin E to beef cattle increases the alpha-tocopherol concentration in muscle and its membranous subcellular fractions. The increased tissue alpha-tocopherol concentration protects not only membranal lipids but also myoglobin from oxidation. This results in delayed onset of discoloration in fresh, ground, and frozen beef and in suppression of lipid rancidity, especially in fresh, ground, and frozen beef and less so in cooked beef. Extension of beef color display life depends on dose level and duration of dietary vitamin E, muscle, and aging period. Cumulative results of experiments conducted to date indicate that beef from animals that receive 500 IU/steer daily of vitamin E for 126 d could assuredly benefit the domestic retail market by extending color display life. Implementation of this technology by the beef industry requires development of a method for rapid determination of alpha-tocopherol concentration in muscle samples collected on the day of harvest.

Several researchers have reported the importance of diet in the overall metabolism of lipids in both humans and animals. The main importance of nutritional lipidomics is to evaluate the

diet-dependent changes in the composition, function, and structure of cellular lipids. In the research associated with nutrition, lipidomics can help understand the function of lipids as a signaling molecule, and their role in metabolic pathways.

Lipidomics also helps to elucidate the relations between nutrients and human metabolism. Another important highlight of lipidomics research is its ability to determine the dietary intake of an individual in a standardized manner in a way that it can precisely analyze the mild to chronic effects of dietary components. Such insights would help design a proper diet chart to promote a lifelong healthy life. More recently, a lipidomics study has shown the underlying molecular mechanism associated with the health benefits of dietary  $\omega$ -3 polyunsaturated fatty acids. It has also evaluated the regulatory role of  $\omega$ -3 and -6 fatty acids in the inflammatory response.

Currently, researchers are applying lipidomics to determine the changes in the quality of chilled beef loins which have been sterilized using irradiation techniques. Sterilization by irradiation is considered as one of the important cold sterilization techniques and is widely used for the sterilization of food such as spices, frozen meat, dehydrated vegetables, etc. This technique is not used for high fat-containing food as it releases a bad odor owing to the oxidation of fats.

However, a high-energy electronic eradiating accelerator could efficiently sterilize such high fat-containing food without fat oxidation. In this study, the scientists have used lipidomics analysis to provide strong proof for the variation in the quality of lipid contents between the sterilization processes.

Lipidomics has been used to analyze infant formulas. In a survey, it has been estimated that in the United States alone two-thirds of infants receive infant formula milk as a primary nutrition source during the first six months of their life. Recently, scientists have analyzed oxidative and non-oxidative lipidomics profiles of several commercially available infant formulas.

The lipidomic fingerprint of the liquid infant formulas showed the presence of an oxidated form of cholesterol (7-ketocholesterol), and a low level of phytosterols. Such data helped the researchers establish a new classification of infant formulas based on their metabolomic fingerprint.

Another interesting application of lipidomics is its utilization as a clinical tool for monitoring metabolic changes in an individual's health. The category of lipid that shows the highest percentage of inheritance is phospholipids.

These lipids are also linked with heritable disease risks. As a change in nutrition can alter the lipid profiles, more work is needed to understand how to prevent the onset of these diseases.

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Jie Zhang  
Institute of Food Science and Technology- CAAS, China E-mail: zhangjie@caas.cn