EFFECTS OF DIETARY FERMENTED FOODS ON THE PRODUCTION OF POTENTIAL CARCINOGENS AND RISK OF COLORECTAL CANCER FROM PROCESSED MEAT PRODUCTS

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I. INTRODUCTION

The 2015 report by the World Health Organization (WHO) and the International Agency for Research on Cancer (IARC) classified red meat as 'probably carcinogenic' and processed meat as 'carcinogenic,' causing major repercussions worldwide [1]. However, some studies have found no significant relationship between the intake of meat and processed meat products and colorectal cancer (CRC) [2]. Fermented foods are typically a good source of beneficial microorganisms (probiotics) and bioactive compounds that provide specific human health benefits [3]. The effects of consuming fermented foods (kimchi, soybean paste, red pepper paste, soy sauce, and salted shrimp) and processed meat products (ham, sausage, and bacon) on the reduction of potential carcinogens and changes in gut microbiota are still insufficient. Furthermore, it is necessary to study whether consuming a lot of fermented foods alters the production of potential carcinogen substances and changes in the gut microbiota associated with processed meat intake. Therefore, this study aims to analyze the production of potentially carcinogenic substances that occur when both fermented products and processed meat are consumed simultaneously and to observe changes in the gut microbiota.

II. MATERIALS AND METHODS

Table 1 Processed meat products and fermented foods analyzed in the mouse model and meat-cooking condition

Processed mea products	Control (Normal diet)	Only processed meat products	With Korean fermented foods				
			Kimchi	Soybean past	Red pepper paste	Soy sauce	Salted shrimp
Ham	-	H1	H2	H3	H4	H5	H6
Sausage	-	S1	S2	S3	S4	S5	S6
Bacon	-	B1	B2	B3	B4	B5	

	Cooking method	Cooking temperature (°C)	Cooking time (min)	
			Front	Back
Ham	Pan-fry		3.5	3.5
Sausage	Pan-fry	180–200	3.0–3.5	3.0–3.5
Bacon	Pan-fry		3.0	2.0

Three types of meat products were cooked as shown in Table 1. After the acclimatization period, the mice were divided into 19 treatments (19 treatments × 5 mice × 2 ages [adult and aged]) and fed with processed meat and fermented foods for 33 days (once every 3 days, 11 times). Furthermore, the mice feces were collected to analyze the HCA contents during the experiment (once every 3 days, 11 times). The microbiota composition was characterized using NGS analysis. Microbial DNA was isolated from 1 g fecal samples using the QIAamp DNA Stool Mini Kit (QIAGEN, Hilden, Germany) according to the manufacturer's protocol and a modified previous study (Lee et al., 2021). High-quality sequences were collected by eliminating chimeric sequences, then taxonomically classified using the SILVA 16S rRNA gene database by machine learning techniques. Carcinoembryonic antigen (CEA) in large intestine of mice is analyzed after dissection of mice. The large intestine sample was weighed and then homogenized in PBS at the ratio of tissue weight (g) to PBS (mL) of 1:9. Then, the homogenates were centrifuged at 5,000 × g for 5 min, and the collected supernatant was used to analyze the CEA levels for estimation of the CRC-related tendency using a CEA kit (Elabscience, TX, USA).

III. RESULTS AND DISCUSSION

In this study, about half of the feed consumed by experimental animals was processed meat; thus, the processed meat intake was high. Nevertheless, no specific health problems were linked to the ingestion of HCAs in the foods among the experimental animals, and most animals remained healthy during the experimental period. The imbalance between pro-inflammatory and anti-inflammatory mediators and dysbiosis of gut microorganisms associated with colitis can eventually lead to CRC. In this study, no significant difference in the CEA levels was found between mice of different ages, and some fermented foods in the bacon-fed groups led to a slight decrease in the CEA level. However, because the morphologies of organs or body weight, which are factors associated with the incidence of CRC, were not significantly different between the groups, this study could not clearly conclude the reduction effect of CEA level by the consumption of fermented foods. Although the results did not reveal a significant effect on the change in gut microbiota depending on the intake of processed meat products and fermented foods, beneficial effects, such as antioxidant activity, anti-mutagenicity, and anti-inflammatory, in fermented foods can be seen to affect changes in the composition of gut microbiota related to colitis or CRC. Moreover, it is difficult to determine the correlation between gut microbiota and the HCAs or development of CRC because there was no influence on the incidence of CRC by the intake of processed meat.

IV. CONCLUSION

This study determined the effects of simultaneous intake of dietary processed meats and fermented foods on the production of potential carcinogens and the risk of CRC in a mouse model. In this study, it is difficult to confirm whether fermented foods directly lower the risk of CRC. In addition, although fermented foods decreased some levels of HCAs and CEA associated with CRC, it is unreasonable to determine that it is an inhibitory effect of CRC. Furthermore, despite the tendency of fermented foods to change the gut microbiota in the mice model, it could be considered that the change in gut microbiota also did not have a significant impact. From the results of this study, although we did not find a clear association between the intake of processed meat products and CRC, we cannot rule this out. These results may be because of the numerous influential variables, such as meat processing method, fermented food, manufacturing method, heating temperature, heating time, and intake period.

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