

Increased Chemopreventive Effects of Fermented Foods by Changing Different Kinds of Salt

Kun-Young Park^{1*}, Gwi-Jung Han², Soon-Ah Kang³ and Ji-Kang Jung¹

¹Dept of Food Science and Nutrition, Pusan National University, Busan 609-735, Korea

²Rural Resource Development Institute, NIAST, RDA, Suwon 441-707, Korea

³Department of Fermented Food Science, Seoul University of Venture and Information, Seoul 135-090, Korea

Keywords : salt, chemopreventive, kimchi, soybean pastes

There are raw salts(Natural salt, Saeng salt), purified salts(NaCl reagent grade, Hanju salt) and processed salt(Gueun salt, Saengkum, Bamboo salt) in Korea. Their major element is NaCl but raw salt from sea water contains other minerals such as K, Mg, S, etc. Mineral rich natural salt is abundant in Ca(1037ppm), K(3701ppm), Mg(10266ppm) and S(7459ppm), and processed salt contained high levels of Ca, K, Mg and Fe. Especially high levels of K, P, Fe and Ge were detected in bamboo salt.

The lipid autoxidation rate and comutagenic effect of various salts were studied in lipid autoxidation system, and Ames assay and SOS chromotest systems. All sorts of the salt exhibited to promote autoxidation of linoleic acid and comutagenicity on N-methyl-N'-nitro-N-nitrosoguanidine(MNNG) in the Ames test system but the levels were different. Among the several salts, processed salts, especially bamboo salt significantly lowered autoxidation and comutagenic effects than others. Purified salts caused the highest autoxidation rate and comutagenic effect.

To reduce the effect of salt on mutagenicity the KCl mixed bamboo salt was developed. All the salts studied showed comutagenic effects on the MNNG in Salmonella typhimurium TA100. One time heat treated KCl bamboo salt exerted the lowest comutagenic activity. In SOS chromotest using *E. coli* PQ37, gueun salt, 9X bamboo

salt, KCl bamboo salt blocked the SOS response induced by MNNG, while purified salt increased the SOS induction factor.

The induction of chromosome aberrations by mitomycin C was increased by pre-treatment with salt. However, gueun salt and 9X bamboo salt significantly decreased the frequency of micronucleated reticulocytes compared to the purified salt($p < 0.05$)

Fermented vegetables (kimchi):

The fermentation characteristics of pH, acidity and chemopreventive activity of kimchi were studied when the kimchi prepared with different kinds of salt(Natural salt(N), Bamboo salt(B), Gueun salt(G) and KCl) and fermented at 15°C. B-KCl kimchi (B used for salting the cabbage and KCl added to the premixture of kimchi) and G-KCl kimchi(G used for salting the cabbage and then KCl added to the premixture of kimchi) changed slowly, indicating increased preservation period. B-KCl and G-KCl kimchi also showed the highest anticancer effect in AGS human gastric adenocarcinoma cells.

The kinds of salt used in kimchi preparation is one of the most important factors to increase functionality of kimchi. The comutagenicity against MNNG significantly increased by purified salt compared to KCl bamboo salt and gueun salt. The KCl bamboo salt increased

antimutagenic and anticancer effects when it used in kimchi preparation. Gueun salt for kimchi preparation also increased cancer preventive activity of kimchi, while purified salt did not.

In other experiment, the kimchi samples were brined with purified salt(P), mineral rich Natural salt(NS), the Natural salt without bittern(NS-B) and Gueun(baked) salt(G) and fermented for 7 days at 15°C. The changes in pH and acidity of the P and G kimchis were slower than those of NS and NS-B kimchis. NS-B and G kimchis promoted the growth of *Leuconostoc* sp, however, it inhibited the growth of *Lactobacillus* sp. when compared with P and NS brined kimchis. The sensory evaluation results indicated that NS-B and G kimchis were better than P or NS kimchi in taste, color and overall acceptability($p < 0.05$). The rheological property of texture (cutting strength) of NS-B and G brined kimchis were also much better. NS-B and G kimchis significantly increased anticancer effects than P or NS kimchi in AGS human gastric cancer cells and HT-29 human colon cancer cells.

Soybean pastes

Chungkukjang (Short-term fermented soypastes):

Chungkukjang prepared with the different kinds of salt had high effects of hydrogen-donating activity and on the inhibition of mutagenicity compared to one prepared without salt, especially chungkukjang prepared with 2% bamboo salt (1X) showed the highest effect. The chungkukjang prepared with the 2% bamboo

salt inhibited significantly the growth of HT-29 human colon carcinoma cells.

Doenjang (Long-term fermented soypastes):

Methanol extracts of doenjang made with four kinds of salt revealed antimutagenic activity toward MNNG, especially doenjang extracts using 1X baked bamboo salt (B1-D) showed 94% inhibition at the 5mg/plate. This doenjang(B1-D) also exhibited the strongest inhibitory effect against MNNG in SOS chromotest.

The kind of salt used in doenjang preparation showed one of the most important factors that affect the chemopreventive activities of doenjang in other experiment. Bamboo salt (1X baked) doenjang(BS1-D) and bamboo salt (9X baked) doenjang showed higher inhibitory effects than PS-D(purified salt doenjang) and NS-D(Natural salt doenjang) on mutagenicity induced by aflatoxin B₁, MNNG and 4-NQO(4-nitroquinoline-1-oxide). BS1-D exerted more suppressive effects on chromosome aberration than NS-D on motimycin C-induced micronucleus in mice. The chemopreventive effect of doenjang was significantly increased by using BS instead of the more typical commercial salts, NS and PS($p < 0.05$). This is probably due to the changes in the chemical and physical properties of the salt, especially increased content of K and P during the processing of BS and to differences in fermented products formed during the doenjang fermentation in the presence of BS.