Improvement of functionality of broccoli sprouts using slightly acidic electrolyzed water

Sprouts are simply germinated seeds of soybean, mung bean, and radish, among others, that are consumed as food. They contain many nutrients and functional components, and provide health benefits. Broccoli sprout, in particular, contains sulforaphane, which has an antioxidant function, and has been attracting attention as a health/functional food. Sulforaphane in broccoli sprout is produced by the myrosinase enzyme from 4-methylsulfinylbutyl glucosinolate (glucoraphanin). Several factors that can promote the accumulation of bioactive compounds have been studied, among them internal factors such as genotypic effect, and external factors including environmental conditions such as light, salinity, sugars, and plant hormones. Slightly acidic electrolyzed water (SAEW) with a near-neutral pH and containing available chlorine concentration (ACC) can be generated by electrolyzing dilute hydrochloric acid using non-membrane electrolytic cell. SAEW has been recognized as having antimicrobial ability and is a promising non-thermal sanitizer for use in the food industry. In Japan, SAEW has been an authorized food additive since 2002 and a specified agricultural chemical since 2014. Previous studies have found that electrolyzed water can enhance the inhibitory activity of angiotensin I-converting enzyme (ACE) in soaked soybeans, influence the germination of mung bean and some grains, elevate the content of γ-aminobutyric acid (GABA) in germinated brown millet, brown rice, and affect antioxidant enzymes in mung bean sprouts. In this study, the effects of SAEW on sulforaphane content and total bacterial count of broccoli sprouts were investigated.

SAEW was prepared with different ACCs (10, 20, 30, 40, 50 ppm) by electrolyzing the tap water with pH 4.35 for a period of time. Broccoli seeds were submerged in different treatment solutions for 3 h. The soaked seeds were then evenly placed on sterile cheesecloth in a polypropylene box consisting of two layers. The upper layer was used for seed germination and the lower layer was filled with the solutions. The seeds were cultivated at 25 °C at a relative humidity of 80% in the dark. The treatment solutions were changed every 24 h until the whole sprouts were harvested after 8 d (Fig. 1). The sulforaphane content increased significantly ($p < 0.05$) by 95% after treatment with SAEW 40 compared with tap water (Fig. 2A). All of the SAEW solutions increased the content of sulforaphane in broccoli sprouts compared with tap water, although the increase between using the SAEW 20 and tap water control treatments was not significant. SAEW 40 significantly enhanced the activity of myrosinase (Fig. 2B). Moreover, the number of microorganisms on the broccoli sprout decreased by 1.71 log CFU/g after using the SAEW with ACC value of 50 mg/L treatment compared with tap water treatment. Figure 3 shows that the bactericidal activity of SAEW on the surface of broccoli sprouts increased as the ACC values increased.

Overall, with a suitable ACC it can be a useful tool for enhancing the amount of sulforaphane and reducing the microbial counts on broccoli sprouts intended for fresh consumption as a functional food.

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Fig. 1. Broccoli sprouts cultivated with slightly acidic electrolyzed water

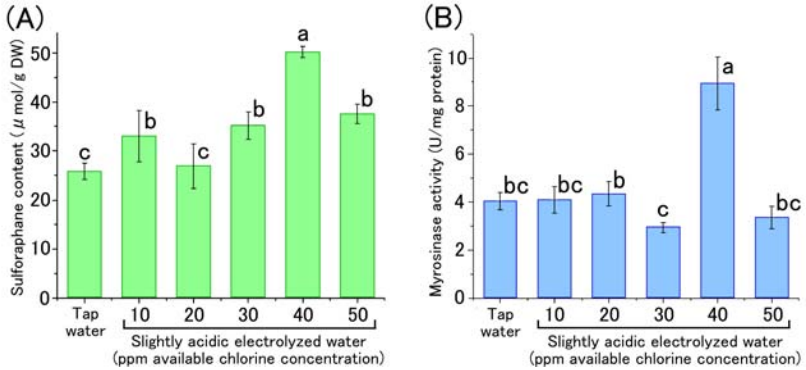

Fig. 2. Sulforaphane content (A) and myrosinase activity (B) of broccoli sprouts treated with different available chlorine concentrations of slightly acidic electrolyzed water.
Different letters mean statistically significant difference (P<0.05).

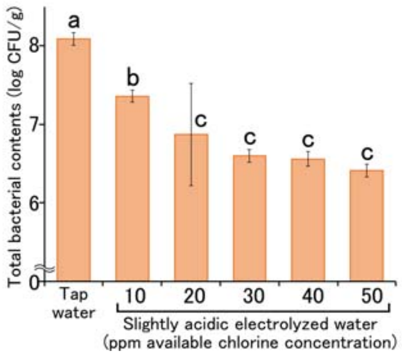

Fig. 3. Total bacterial counts on broccoli sprouts treated with slightly acidic electrolyzed water. Different letters mean statistically significant difference (P<0.05).