P-04-01

Subacute feeding toxicity of low-sodium sausages manufactured with sodium substitutes and biopolymer-encapsulated saltwort (Salicornia herbacea) in a mouse model (#95)

Eun Young Jung, Da Young Lee, On You Kim, Seung Yun Lee, Sun Jin Hur

Chung-Ang University, Animal Science and Technology, Anseong-si, South Korea

Introduction

Numerous studies have reported that excessive sodium intake has a negative impact on human health. Extensive research has focused on the development of salt substitutes or replacements in meat products. We developed a plant-based salt with two approaches to reducing sodium consumption. The first approach replaced 55 % sodium with alternative substitutes KCl, $MgCl_2$, and $CaCl_2$. The second approach reduced sodium absorption encapsulation by biopolymers (chitosan, cellulose, dextrin, and pectin).

Methods

Low-sodium sausages were manufactured by sodium substitution and biopolymer encapsulation, and a diet comprising 10% treatment sausages (6 treatment groups: C: 100 % NaCl, T1: 55 % sodium substitute + 45 % saltwort salt), T2 (55 % sodium substitute + 45 % saltwort salt with chitosan), T3 (55 % sodium substitute + 45 % saltwort salt with cellulose), T4 (55 % sodium substitute + 45 % saltwort salt with dextrin), and T5 (55 % sodium substitute + 45 % saltwort salt with pectin)) were added to a 90 % commercial mouse diet for 4 weeks.

Results

Body weight increased (though not significantly) after 4 weeks of feeding in all treatment groups. In this study, body weight ranged from roughly 22 g to 34 g. This is standard body weight for ICR mice. Throughout the experiment, all the mice looked healthy, and no abnormal behavior or clinical pain/distress symptoms (dehydration, incontinence, soiled fur, sunken eyes, closed lids, wasting back muscles, a sunken or distended abdomen, unresponsiveness, hunched posture, and scratching or biting) were observed. Feed intake did not differ among the treatment groups (data not shown). Thus, dietary low-sodium sausage had no effect on body and organ weight loss.

After 4 weeks of feeding, white blood cell, red blood cell, hemoglobin, hematocrit, mean corpuscular hemoglobin, platelet, mean platelet volume, procalcitonin, and WBC differential counting were significantly different with no consistent trends among the treatments.

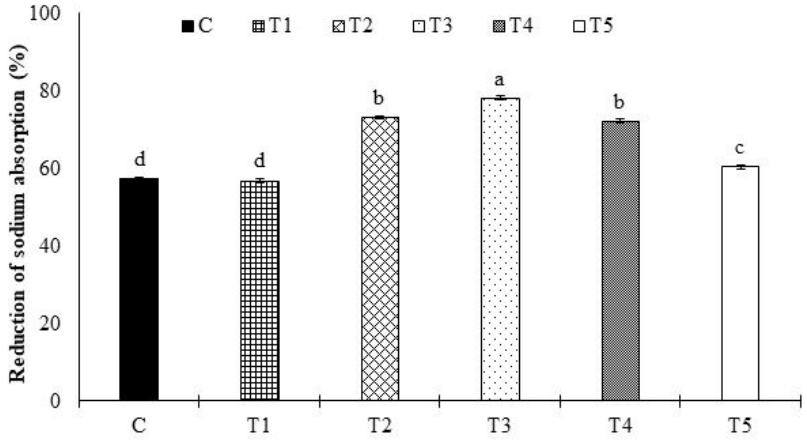
Biopolymer encapsulated saltwort groups (T2 - T5) were shown to have a higher sodium absorption rate reduction than the control and T1 (sodium substitute and saltwort without encapsulation). Among the biopolymer encapsulated saltwort groups, T3 (cellulose encapsulated saltwort group) resulted in the highest inhibition of sodium absorption.

Although example reference ranges of toxicity are given, these values may vary depending on animal species, breed, age, gender, diet, or analysis method, and the results of toxicity tests may vary depending on the experimental conditions. Therefore, the subacute feeding toxicity results in this study were evaluated by comparing the differences with the control group, as well as by referring to the results of previous studies.

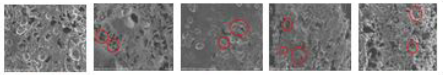
Conclusion

The toxicity of low-sodium sausages manufactured by Na substitutes and biopolymer encapsulated saltwort was determined in a mouse model. Although certain toxicity test levels differed among dietary treatment groups, all levels were within normal reference ranges. Moreover, there were no significantly different results between the test groups and the control group, suggesting that all low-sodium sausages are safe in terms of subacute toxicity. Among the samples, sausage manufactured using Na substitutes and cellulose encapsulated saltwort was shown to have the best Na absorption inhibition rate without toxicity in this study. As shown in the final product images of Table 1, sausage appearance is normal and unpublished data show no difference in sensory evaluation tests among samples. Therefore, low-sodium sausage produced with Na substitutes and biopolymer-encapsulated saltwort are not toxic and can be commercialized.

Notes



Effect of sodium substitutes and biopolymer encapsulated saltwort (Salicornia herbacea) in low-salt

Ingredients		Formula (%)					
		C	T1	T2	T3	T4	T5
Pork meat		72.44	69.44	69.44	69.44	69.44	69.44
Fat		11.20	11.20	11.20	11.20	11.20	11.20
Ice		13.80	13.80	13.80	13.80	13.80	13.80
$NaNO_2$		0.01	0.01	0.01	0.01	0.01	0.01
Phosphate		0.20	0.20	0.20	0.20	0.20	0.20
Sugar		0.50	0.50	0.50	0.50	0.50	0.50
Monosodium glutamate		0.05	0.05	0.05	0.05	0.05	0.05
Sausage spice		0.40	0.40	0.40	0.40	0.40	0.40
NaCl		1.40	-	-	-	-	-
Saltwort salt		-	0.63	-	-	-	-
Saltwort salt with chitosan		-	-	0.63	-	-	-
Saltwort salt with cellulose		-	-	-	0.63	-	-
Saltwort salt with dextrin		-	-	-	-	0.63	-
Saltwort salt with pectin		-	-	-	-	-	0.63
Na substitutes	KCl	-	0.56	0.56	0.56	0.56	0.56
	$MgCl_2$	-	0.14	0.14	0.14	0.14	0.14
	$CaCl_2$	-	0.07	0.07	0.07	0.07	0.07
Total ingredients		100	100	100	100	100	100
Sodium substitution rate		0	55	55	55	55	55
Biopolymer encapsulation with saltwort							
Final products							

Formulation (%) of sausages.

Notes