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Sodium-Reduced Meat and Poultry Products Contain a Significant Amount of Potassium from Food Additives

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ABSTRACT

Background Sodium-reduced packaged food products are increasingly available to consumers; however, it is not clear whether they are suitable for inclusion in a potassium-reduced diet. For individuals with impaired renal potassium excretion caused by chronic kidney disease and for those taking certain medications that interfere with the rennin-angiotensin aldosterone axis, the need to limit dietary potassium is important in view of the risk for development of hyperkalemia and fatal cardiac arrhythmias.

Objective The primary objective of this study was to determine the impact of the reduction of sodium in packaged meat and poultry products (MPPs) on the content of potassium and phosphorus from food additives.

Design This was a cross-sectional study comparing chemically analyzed MPPs (n=38, n=19 original, n=19 sodium-reduced), selected from the top three grocery chains in Canada, based on market share sales. All MPPs with a package label containing a reduced sodium content claim together with their non-sodium-reduced packaged MPP counterparts were selected for analysis. The protein, sodium, phosphorus, and potassium contents of sodium-reduced MPPs and the non-sodium-reduced (original) MPP counterparts were chemically analyzed according to the Association of Analytical Communities official methods 992.15 and 984.27 and compared by using a paired *t* test. The frequency of phosphorus and potassium additives appearing on the product labels' ingredient lists were compared between groups by using McNemar's test.

Results Sodium-reduced MPPs (n=19) contained 44% more potassium (mg/100 g) than their non-sodium-reduced counterparts (n=19) (mean difference [95% CI): 184 [90-279]; P=0.001). The potassium content of sodium-reduced MPPs varied widely and ranged from 210 to 1,500 mg/100 g. Potassium-containing additives were found on the ingredient list in 63% of the sodium-reduced products and 26% of the non–sodium-reduced products (P=0.02). Sodium-reduced MPPs contained 38% less sodium (mg/100 g) than their non–sodium-reduced counterparts (mean difference [95% CI]: 486 [334-638]; P<0.001). The amounts of phosphorus and protein, as well as the frequency of phosphorus additives appearing on the product label ingredient list, did not significantly differ between the two groups.

Conclusions Potassium additives are frequently added to sodium-reduced MPPs in amounts that significantly contribute to the potassium load for patients with impaired renal handling of potassium caused by chronic kidney disease and certain medications. Patients requiring potassium restriction should be counseled to be cautious regarding the potassium content of sodium-reduced MPPs and encouraged to make food choices accordingly.
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THE REDUCTION OF SODIUM IN PROCESSED FOODS IS a key component of population-wide health strategies being implemented by various countries in an effort to reduce the sodium intake of individuals.[1] Current American and Canadian recommendations specify for food manufacturers to lower the sodium content of their food products.[2,3] Because sodium chloride acts to preserve and enhance the taste and texture of meat and poultry products (MPPs), food manufacturers may use phosphorus and potassium additives to replace the functional and flavor properties of sodium chloride.[4]

Phosphorus additives are increasingly being added to MPPs because they increase shelf-life, retain moisture, maintain color, and improve texture.[5,6] Studies have demonstrated that phosphorus additives are highly bioavailable (almost 100%) and significantly contribute to the dietary phosphorus load,

which can contribute to hyperphosphatemia and its respective complications in patients with chronic kidney disease.[7-12] Of additional concern, recent studies conducted in the general population have shown an association between higher serum phosphorus levels and/or higher dietary phosphorus intake and adverse cardiovascular outcomes.[13-15]

Potassium additives, such as potassium chloride, confer a salty taste and are often used for sodium replacement in sodium-reduced foods.[16] Potassium lactate and potassium phosphate have the added benefits of improving shelf-life and moisture retention in MPPs.[4,17-19] Published evidence suggests that a diet high in potassium from fruits, vegetables, and low-fat dairy products is associated with a significant blood pressure–lowering effect and may be advantageous to the general population.[20,21] However, the consequences of increased potassium load from food additives is unknown and may contribute to hyperkalemia and fatal arrhythmias in patients with chronic kidney disease. Life-threatening hyperkalemia caused by use of potassium-containing salt substitutes has been reported to affect individuals with impaired renal excretion, as well as patients with heart disease.[22,23] The risk of hyperkalemia is increased with the use of medications, such as angiotensin-converting enzyme inhibitors, angiotensin II receptor blockers, and potassium-sparing diuretics, especially when they are taken concomitantly with salt substitutes.[24]

Patients with many chronic diseases, such as hypertension, heart failure, and kidney disease, are advised to follow a sodium-restricted diet. These patients are often educated about various ways to reduce sodium intake, which include choosing low-sodium food alternatives.[25] Because of the possible inclusion of phosphorus and potassium additives as sodium replacements, sodium-reduced foods may not be suitable for inclusion in a renal diet. Currently, the phosphorus content of foods is not required to be on the Nutrition Facts table of packaged food labels. Although recent legislation in both the United States[26] and Canada[27] has mandated the inclusion of potassium on food labels, "potassium" will begin to appear on Nutrition Facts table during a transition period. Nutrient databases typically do not include the contribution from food additives in the nutrition composition for foods.[10] Patients and health care providers may therefore find it challenging to make and recommend appropriate food choices, respectively. No other study has examined the impact of lowering the sodium content of foods—in particular, the change in potassium and phosphorus content—between reduced sodium foods and the original products. This outcome is especially relevant to the many patients with impaired renal function. The primary objective of this study was to determine the impact of the reduction of sodium in MPPs on the content of potassium and phosphorus from food additives.

MATERIALS AND METHODS

This study utilized a cross-sectional design to examine chemical analysis of sodium, potassium, phosphorus, and protein in MPPs (n=38; n=19 original, n=19 sodium-reduced). Six grocery stores from the three largest grocery store chains in Canada by market share,[28] situated near St Michael's Hospital in Toronto, were scanned for sodium-reduced MPPs in May 2014. An inclusive sample of sodium-reduced MPPs (n=19), each having a corresponding original non-sodium-reduced MPP counterpart (n=19), was selected. A product was considered to be sodium reduced if the package label had a nutrient content claim stating the percentage reduction in sodium (eg, "25% less sodium than our original product"). The "original product" of the same brand as the sodium-reduced product was selected as the original non-sodium-reduced counterpart. This study was deemed exempt by the Research Ethics Board of St Michael's Hospital in accordance with the Canadian Institutes of Health Research, Natural Sciences and Engineering Council of Canada, and Social Sciences and Humanities Research Council of Canada, Tri-council Policy statement: Ethical Conduct for Research Involving Humans, December 2010.

All original food packages were retained for labeling information. A minimum of 200 g product was cooked according to package directions, stored in a resealable plastic bag, and kept at 5°C until analysis was performed. Cooked MPPs were shipped on ice to Maxxam Analytics (Mississauga, Ontario, Canada) for nutrient analysis. On receipt, the MPP samples were homogenized, and duplicate aliquots were

Table 1. Comparison of nutrient concentrations in sodium-reduced and original (non-sodium-reduced) meat and poultry products[a]

Nutrient[b]	Sodium-Reduced Mean±SD[c] (n=19)	Original Mean±SD (n=19)	Mean paired difference (95% CI)	*P* value[d]	Mean percent change±SD
Sodium	749±299	1,235±548	−486 (−638, −334)	<0.001	↓ 38±11
Potassium	568±334	384±169	184 (90, 279)	0.001	↑ 44±43
Phosphorus	254±75	267±84	−13 (−34, 8)	0.198	—
Protein	24±9	23±9	1 (−0.8, 3)	0.261	—
Phosphorus-protein ratio	10.8±2.7	11.9±3.0	−1.1 (−1.9, −0.3)	0.009	↓ 8±13

[a]Products are Canadian meat and poultry products.
[b]Sodium, potassium, and phosphorus are reported in mg/100 g. Protein is reported in g/100 mg. Phosphorus-to-protein ratio is expressed as mg phosphorus/g protein.
[c]SD=standard deviation.
[d]Statistical analyses comparing matched pairs of original and sodium-reduced meat and poultry products were done using paired *t* tests. $P<0.05$ was considered statistically significant.