CPE The Impact of Additives on the Phosphorus, Potassium, and Sodium Content of Commonly Consumed Meat, Poultry, and Fish Products Among Patients With Chronic Kidney Disease

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Objective: Patients with chronic kidney disease (CKD) are advised to limit their dietary intake of phosphorus and potassium as hyperphosphatemia and hyperkalemia are both associated with an increased risk of mortality. There is uncertainty concerning the actual content of these minerals in the Canadian food supply, as phosphorus and potassium are increasingly being used as food additives. This study aimed to determine the impact of food additives on the chemically analyzed content of phosphorus, potassium, sodium, and protein in commonly consumed meat, poultry, and fish products (MPFs).

Design: Foods representing commonly consumed MPF identified by a food frequency questionnaire in dialysis patients were purchased from three major grocery store chains in Canada. MPF with and without phosphorus and potassium additives listed on their ingredient list (n = 76) as well as reference MPF that was additive free (n = 15) were chemically analyzed for phosphorus, potassium, sodium, and protein content according to Association of Analytical Community official methods.

Results: Phosphorus, potassium, and sodium additives were present on the ingredient list in 37%, 9%, and 72% of MPF, respectively. Among MPF categories that contained a phosphorus additive, phosphorus content was significantly ($P < .05$) higher in MPF with phosphorus additives versus MPF without phosphorus additives and MPF reference foods (median [min, max]): (270 [140, 500] mg/100 g) versus (200 [130, 510] mg/100 g) versus (210 [100, 260] mg/100 g), respectively. Among MPF categories containing a potassium additive, foods listing a potassium additive had significantly more ($P < .05$) potassium than foods that did not list potassium additives and reference foods (900 [750, 1100] mg/100 g) versus (325 [260, 470] mg/100 g) versus (420 [270, 450] mg/100 g).

Conclusions: The use of additives in packaged MPF products as indicated by the ingredient list can significantly contribute to the dietary phosphorus and potassium loads in patients with CKD. Patients with CKD should be educated to avoid MPF foods listing phosphorus and/or potassium additives on the ingredient list, which may lead to improved dietary adherence.

This article has an online CPE activity available at www.kidney.org/professionals/CRN/ceuMain.cfm

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Introduction

CARDIOVASCULAR DISEASE IS a leading cause of mortality among patients with chronic kidney disease (CKD).[1] Hyperphosphatemia is associated with cardiovascular mortality,[2–4] hyperkalemia can lead to an increased risk of fatal arrhythmias or sudden cardiac death,[5] and hypertension is a modifiable risk factor for cardiovascular disease.[6] As a result, low phosphorus, potassium, and sodium diets are often prescribed to patients with CKD and form an integral part of their nutritional therapy to manage and prevent hyperphosphatemia, hyperkalemia, and hypertension.[7]

Adherence to low phosphorus, potassium and sodium diets are becoming increasingly difficult due to the addition of additives to foods. Phosphorus additives are often added to meat, poultry, and fish (MPF) products to extend shelf life, improve texture, and preserve moisture.[8] Sodium phosphates can also be injected into solid cuts of meat and poultry, in which case the meat and poultry may be labeled as "enhanced" (United States) or "seasoned"

(Canada). Several studies conducted in Europe and the United States have demonstrated that phosphorus additives significantly contribute to the phosphorus content of food.[9-14] Recently, Carrigan et al.[15] compared chemically analyzed foods from a low additive and an additive-enhanced 4-day menu. The study demonstrated that a processed diet rich in additives had a 60% higher phosphorus and sodium content compared to the low additive diet. To our knowledge, there is no published data on chemically analyzed food items containing phosphorus additives in Canada.

There is a growing concern that potassium additives can substantially contribute to the potassium content of foods and would be highly bioavailable[16,17]; however, a limited number of studies have been conducted.[13,18]

The problem of additives is compounded by the fact that reporting phosphorus and potassium levels on food labels are currently voluntary and thus may not be listed on the Nutrition Facts table of food packages.[19,20] Also, nutrient databases generally are not updated to reflect the higher phosphorus content of foods containing additives.[14] Therefore, this creates uncertainty as to which foods are appropriate to consume on a renal diet.

There is additional difficulty for patients with end-stage renal disease who are receiving dialysis, as they are educated to increase their intake of high biological value protein, such as MPF.[21] Previous studies have shown that MPF products may be unintended sources of excess phosphorus and potassium due to the use of additives.[10-13]

The aim of this study was to gain knowledge of the actual content of phosphorus and potassium in MPF products commonly consumed among the CKD population. The specific objectives were to determine whether and to what extent the chemically analyzed phosphorus, potassium, sodium, and protein contents differs among commonly consumed MPF products with and without additives listed on their ingredient list and among poultry products with and without the term "seasoned" on the product label.

Methods

Types of MPF products most frequently consumed by hemodialysis and peritoneal dialysis patients (n = 67) were identified using a food frequency questionnaire (FFQ) administered during July–September 2013. The FFQ consisted of 23 questions related to MPF consumption, which were extracted from the Canadian Diet History Questionnaire II, National Institute of Health, adapted for Canada.[22] The FFQ questions asked about the frequency, amount, and types of MPF consumed, and results are reported elsewhere.[23] Foods were ranked according to consumption, as grams and/or servings per month, and the top eight food items were identified as commonly consumed MPF categories.

Products from each type of commonly consumed MPF categories namely: unbreaded chicken, ground beef, steak, white fish, beef burgers, deli meats, bacon, and shrimp were purchased from the top three grocery stores by market share in Canada.[24] A concerted effort was made to purchase store brands and national brands of each type of MPF product. If there were multiple brands, products that occupied the most shelf space were chosen. In order to further examine the contribution of additives, comparable reference products were also chosen for each category of MPF product. A reference product was defined as a fresh MPF item that contained no added ingredients or additives. These products were purchased from local butchers or from companies that could confirm that no additives were added to the product.

A minimum of 150 g of MPF product was preweighed and cooked according to package directions. If package directions were not available, foods were cooked until they reached a safe internal cooking temperature.[25] Once cooked, foods were stored in a resealable plastic bag and kept refrigerated at 5°C until analysis. All food packaging was retained for product label information. A product was considered "seasoned" if the word seasoned appeared anywhere on the food packaging. A product was considered to contain phosphorus, potassium, or sodium additives if such additives were listed on the ingredient list. Foods sold at a deli, meat, or seafood counter in Canada are not required to list their ingredients for consumers. Original package information with an ingredient list was obtained from the deli counter personnel to determine if deli ham, shrimp, and rotisserie chicken contained phosphorus, potassium, or sodium additives. Ingredient information was not available for uncooked sole and tilapia sold at a seafood counter, and therefore, the use of additives as ingredients in these products was not known. For the purpose of analysis, these foods were considered to be in the "no additive" group.

The analyses for the protein, phosphorus, potassium, and sodium content of food were performed by Maxxam Analytics (Mississauga, Ontario). Samples were homogenized, and a portion was used for nutrient analysis. Protein was analyzed according to the Association of Analytical Communities official method 992.15 by combustion using TruMac™ N (LECO Corporation, St Joseph, MI). The total nitrogen was multiplied by the factor 6.25 to calculate the protein content. Samples were run in batches, and the instrument was corrected for daily calibration drift. A blank, reference material, EDTA (ethylenediaminetetraacetic acid) check, and duplicate of a random sample were run for each batch. A continuous calibration blank and continuous calibration verification check were also run between batches.

Phosphorus, potassium, and sodium content were determined according to the Association of Analytical Community official method 984.27. The samples were digested in a mixture of nitric and hydrochloric acid and then analyzed by inductively coupled plasma–optical emission