Nutrición Hospitalaria

Nutr Hosp. 2015;31(1):458-465
ISSN 0212-1611 • CODEN NUHOEQ
S.V.R. 318

Original / *Otros*

Macronutrients and energy content of oral hospital diet prescribed to chronic kidney disease patients on conservative treatment

Janiara David Silva J.[1], Karine A. Louvera Silva[1], Sueli R. Baggio[2], Marcelo A. Morgano[2], Aline S. Aguiar Nemer[1] and Késia D. Quintaes[1]

[1]*Ouro Preto Federal University (UFOP), School of Nutrition, Ouro Preto, Minas Gerais.* [2]*Institute of Food Technology (ITAL), Center of Foods Science and Quality, Campinas, São Paulo. Brazil.*

Abstract

Introduction: **The contribution of diet and treatment planning in the treatment of Chronic Kidney Disease (CKD) has been recognized as having a significant clinical impact if introduced early.**

Objective: **determine the levels of carbohydrates, proteins, lipids, energy and energy density (ED) in an oral hospital diet prescribed to CKD patients, and to evaluate the adequacy of this diet with respect to dietary recommendations.**

Methods: **Diets were collected in a Brazilian public hospital on two non-consecutive days of six different weeks. The carbohydrate, protein, and lipid (total, saturated, monounsaturated, polyunsaturated, linoleic, linolenic and *trans* fatty acids) contents were determined in a laboratory. The amount of energy and the ED of the diets were calculated using the correction factor Atware and by dividing the total energy of the diet by weight, respectively.**

Results and Discussion: **About 14.3% of the diets produced for patients with CKD were analyzed. The average density of the diets was low (0.7 kcal/g). In terms of nutritional adequacy, the average lipid content (15%) and linolenic fatty acid content (0.4%) were below the recommendation, as was energy (23.4 kcal / kg / day). The average carbohydrate content (63.5%) and protein content (1.0 g/kg/day) exceeded the recommendations levels.**

Conclusion: **The oral hospital diet prepared for patients with CKD were considered unbalanced, and an unfavorable clinical treatment for these patients.**

(*Nutr Hosp*. 2015;31:458-465)

DOI:10.3305/nh.2015.31.1.7738

Key words: *Clinical nutrition. Energy. Malnutrition. Nutritional education. Protein. Diet therapy.*

MACRONUTRIENTES Y CONTENIDO DE ENERGÍA DE LA DIETA HOSPITALARIA ORAL RECIBIDO POR PACIENTE CON ENFERMEDAD RENAL CRÓNICA EN TRATAMIENTO CONSERVADOR

Resumen

Introducción: **La contribución de la dieta y planificación del tratamiento en el tratamiento de la enfermedad renal crónica (ERC) ha sido reconocida por tener un impacto clínico significativo si introducida tempranamente.**

Objetivo: **determinar los niveles de hidratos de carbono, proteínas, lípidos, energía y densidad de energía (DE) en una dieta hospitalaria oral recetada para los pacientes con ERC, y evaluar la adecuación de esta dieta con respecto a las recomendaciones dietéticas.**

Métodos: **Las dietas fueron recogidas en un hospital público brasileño en dos días no consecutivos de seis semanas diferentes. Los contenidos de los hidratos de carbono, proteínas, y lípidos (totales, saturadas, monoinsaturadas, poliinsaturadas, ácidos grasos linoleico, linolénico y *trans*) fueran determinados en un laboratorio. La cantidad de energía y la DE de las dietas se calcularon utilizando el factor de corrección de Atware, dividiendo la energía total de la dieta en peso, respectivamente.**

Resultados y Discusión: **Fueran analizadas cerca de 14.3% de las dietas producidas y servidas a los pacientes con ERC. La densidad media de las di etas fue baja (0,7 kcal/g). Fue encontrada inadecuación nutricional para el contenido medio en lípidos (15%) y contenido de ácido graso linolénico (0,4%) y de energía (23,4 kcal/kg/día). El contenido de carbohidratos (63,5%) y el contenido de proteínas (1,0 g/kg/día) superaron los niveles de recomendaciones.**

Conclusiones: **La dieta hospitalaria oral preparada para los pacientes con enfermedad renal crónica se muestra desequilibrada y desfavorable para el tratamiento clínico de los pacientes.**

(*Nutr Hosp*. 2015;31:458-465)

DOI:10.3305/nh.2015.31.1.7738

Palabras clave: *Nutrición clínica. Energía. Desnutrición. Educación nutricional. Proteínas. Dieto terapia.*

Correspondence: Kesia Diego Quintaes.
Ouro Preto Federal University.
School of Nutrition – DENCS.
Campus Morro do Cruzeiro, s/n.
Bauxita, Ouro Preto, MG, Brazil.
E-mail: kesia@enut.ufop.br

Recibido: 5-VII-2014.
Aceptado: 23-VII-2014.

Abbreviations

CKD: Chronic Kidney Disease.
DHA: Docosahexanoic Acid.
ED: Energy Density.
EPA: Eicosapentanoic Acid.
FA: Fatty Acids.
TEV: Total Energetic Value.
SFA: Saturated Fatty Acids.
TL: Total Lipid Content.

Introduction

The contribution of the diet as a therapeutic plan in the treatment of chronic kidney disease (CKD) has long been recognized, presenting a great clinical impact when introduced precociously. The diet is capable of influencing the biochemical hematological parameters, minimizing uremic complications and contributing to an adequate nutritional state for CKD sufferers[1]. The kidney transplantation is the last therapy apply to these patients and could result in a high prevalence of overweight and obesity especially during the first year after the transplant[2].

Restriction of proteins in the diet was one of the first dietary-therapeutic objectives in the treatment of patients in the pre-dialysis phase of CKD, aiming to promote reduced serum levels of nitrogen compounds[3]. Various studies have shown that a protein-restricted diet reduces the production of urea, creatinine and uric acid, being capable of alleviating the uremic symptoms[1,4] and retarding progression of the disease[1].

According to the Kidney Disease Outcomes Quality Initiative (2002)[5] in addition to controlling proteins in the diet, the control of glycemia and of the blood pressure are also important therapeutic targets for these individuals, considering that diabetes *mellitus* (DM) and high blood pressure are the main causes of CKD. According to Chen et al. (2003)[6], insulin resistance, represented by high plasma glucose and serum insulin is present in chronic kidney patients with a glomerular filtration rate below 60 mL/min/1.73m^2. Minimal increases in glycemia are associated with deterioration in kidney function, the greater the degree of insulin resistance, the greater the risk of an early development of kidney disease[7].

Considering the fact that cardiovascular diseases are the main cause of death amongst CKD patients[8], treatment of the risk factors for these pathologies could minimize adverse cardiological effects in any phase of the disease[5]. Life style modifications are considered as important preventative measures, including a reduction in sodium ingestion and in the consumption of lipids with an unfavorable profile for the development of cardiovascular disease [9]. According to Landecho *et al*. (2011)[7], obesity and hypertriglyceridemia increase the risk of developing precocious CKD by two and three times, respectively.

There is an increasing interest in the quality of diet lipids as a function of their relationship with the development of cardiovascular diseases, such as saturated fatty acids (SFA), *trans* fats and cholesterol, since these are the principal contributors to an increase in low density lipoprotein[9]. Nevertheless the nutritional recommendations for specific macronutrients for CKD sufferers only cover the protein and energy values[5]. Thus recommendations for the healthy population have been adopted for CKD sufferers, such as the Food Agriculture Organization of the United Nations[10], which aim at the prevention and treatment of diabetes and of cardiovascular diseases.

Taking account that the fact that the hospital oral diet should be considered a useful tool for the nutritional education of the patients, the objective of this study was to determine the carbohydrate, protein and lipid contents and also the energy value of oral hospital diets elaborated for patients with CKD, and evaluate the percent adequacy according to nutritional recommendations.

Methods

This cross-sectional exploratory study was carried out with samples of oral hospital diets offered to patients with CKD hospitalized in a National Health Hospital in the city of Belo Horizonte, Minas Gerais, Brazil. The study was evaluated and approved by the Ethics in Research Committee of the Mario Penna Foundation (CAE 0001.0.261.238-11).

The samples were taken in duplicate always on two non-consecutive days in different weeks of the months of May and September of 2010 and January of 2011, covering a 6 week period (42 days). Sample collections of each meal: breakfast, collation, lunch, snack, dinner and supper of the oral kidney diets were carried out at the normal time for offering the oral diet, following the regular hospital pattern.

Each meal was weighed on an electronic balance with a capacity for 15kg and sensitivity of 2 grams (Filizola, Pluris Top, São Paulo, SP, Brazil), and homogenized in a multiprocessor with a plastic helix. Aliquots corresponding to 10% by weight of each meal were taken and stored under refrigeration for subsequent preparation of a homogenous mix. Duplicate 50 g samples were separated, stored in zip-lock bags, labeled and frozen (-18ºC) until chemically analyzed in the laboratory (Fig. 1).

Chemical analyses

Determination of moisture content

The moisture content was determined according to the Association of Official Analytical Chemists[11], based on the indirect determination of the water in the

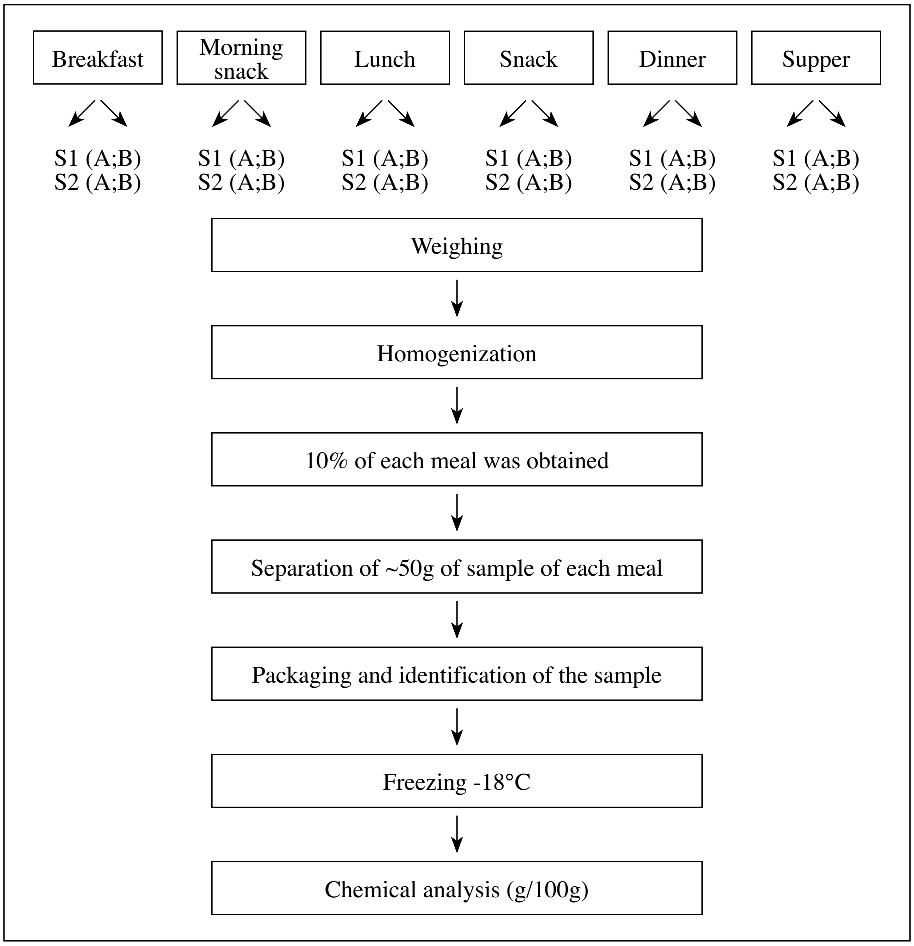

Fig. 1.—Flow diagram of sampling the meals that composes oral renal diets on two non-consecutive days of moths January (2011), May and September (2010). S1=sample 1; S2=sample 2.

food by a gravimetric method. The water is eliminated by heating in a vacuum oven and the mass of the dry residue determined. The moisture content was calculated from the difference in mass of the food before and after drying. The use of a vacuum oven allows one to dry the sample at lower temperatures than those necessary at atmospheric pressure, minimizing degradation of labile compounds in the sample.

Ash determination

The Association of Official Analytical Chemists methodology was used to determine the ash content[11]. The method consists of incinerated the sample in a muffler at 550ºC, promoting evaporation of the water and of the volatile substances and oxidation of the organic matter. The residue remaining after incineration is known as the ash or fixed mineral residue and is quantified gravimetrically.

Total lipids and fatty acids

The total lipid content (TL) was determined by acid hydrolysis with boiling HCl, followed by extraction of the TL with petroleum ether[12]. The TL contents were obtained gravimetrically and the results expressed in g/100g of sample.

In order to analyze the fatty acids (FA), an aliquot of the lipid extract containing about 400 mg of lipids was dried in an evaporator, and then transmethylated using the Hartman & Lago (1973)[13] method, using an ammonium chloride solution and sulfuric acid in methanol for esterification. The identification and quantification of the FA was carried out in a gas chromatograph equipped with an automatic sampler, split injector, 75:1 ratio, CP-SIL 88 capillary column (100 m x 0.25 mm i.d., 0.20 μm of film), flame ionization detector (FID) and a data acquisition workstation. The chromatographic conditions were as follows: programmed column temperature starting at 120ºC/5min, rising to 235ºC at 5ºC/min and remaining at this temperature for 15 minutes, stripping gas of hydrogen at a rate of 1mL/min, make-up gas of nitrogen at 30 mL/min, injector temperature of 270ºC, detector temperature of 310ºC and injection volume of 1 μl. The FAs were identified by a comparison of their retention times with those of co-chromatographic FA standards. Quantification was done by normalization of the area and the results expressed in g/100g of sample.

Proteins

The proteins were determined by the micro Kjeldahl method[15], transferring a 0.3 g sample to a digestion tube, adding a catalyst mixture (copper sulfate, potassium selenium sulfate and concentrated sulfuric acid) and heating. After a determined period of digestion, all the nitrogen transformed into ammonium sulfate was converted into gaseous ammonia after alkalinization of the medium with a concentrated sodium hydroxide solution. A Tecator Kjeltec 2200 automatic distillation unit was used to distill the nitrogen, which collects the distilled ammonia in a boric acid solution containing an acid-base indicator.

The nitrogen content was calculated by titration of the boric acid with a solution of standard hydrochloric acid, and converted to protein content by multiplying with a specific correction factor for that product or the generic one for proteins of 6.25. The result was expressed in g protein/ 100 g of sample.

Carbohydrates

The carbohydrate content was determined by difference, where the sum of the total moisture, ash, lipid and protein contents was subtracted from 100 using the formula: 100 - (g/100 g moisture + g/100 g ash + g/100 g protein + g/100 g total lipids).

Determination of the energy value and energetic density of the diets

The Atware correction factors were used to calculate the energetic value of the sample, which adopts a single value for each energetic substrate of 4 calories per gram of protein or carbohydrate and 9 for each gram of lipids[14]. The sum of the multiplication of these factors by the quantity of the respective nutrients resulted in the total energetic value (TEV). The energetic density (ED) of the diet was calculated by dividing the energetic value by the weight of the respective diet[17], and classified as follows: very low energetic density (0 to 0.6 kcal/g), low ED (0.7 to 1.5 kcal/g), medium ED (1.5 to 4 kcal/g) and high DE (4.0 to 9.0 kcal/g) according to the Center for Disease Control and Prevention (2005)[15].

Nutritional adequacy

A diet with an energetic value corresponding to 1500 kcal was adopted for the calculation of the adequacy of the carbohydrate, protein and lipid contents, this value being that used by the hospital nutrition service where the study was carried out. The adequacy of the nutrient contents and energy of the diets was determined for both adults and elderly individuals of both sexes, considering as adults individuals aged from 19 to 59 years and as elderly individuals those over 60 years. A body weight of 60 kg was adopted for the calculations of nutritional adequacy[16].

The criteria established by Kidney Disease Outcomes Quality Initiative (2002)[5] were used to evaluate the adequacy of the protein and energy contents, whereas the values defined by the Diretriz Brasileira de Diabetes (2009)[17] and FAO (2010)[10] were adopted to evaluate the adequacy of the carbohydrates and lipids, respectively (Table I).

Statistical analyses

The statistical analyses were carried out using the PASW version 17.0 software and the results expressed as the arithmetic mean and standard deviation. The normality and homoscedasticity of the data were verified by the Shapiro-Wilk and Levene tests, respectively. The analysis of variance (ANOVA) followed by the Bonferroni post-hoc test were used when the variables showed a normal distribution, and the Kruskal-Wallis and Mann-Whitney U tests when the conditions were non-parametric. The level of significance was set at $p<0.05$.

Results

Thirty-six meals served to patients with CKD were studied, representing 14.3% of the menus produced. The diets analyzed in the present study had, on average 1393 kcal, about 7% less than the value contained in the diet manual used by the hospital nutrition service (1500 kcal). There was a significant difference in the nutrient and energy contents between the months studied ($p<0.05$), but the diets studied were always inadequate with respect to the nutrients evaluated and carried an insufficient amount of energy (Table I).

In the three periods studied, the diet presented a mean carbohydrate content of 3.9 g/kg/day, with similar values for carbohydrate and energy in January of 2011 and September of 2010. Only in May did the diets comply with the recommendation. The protein contents of the diets were higher than the maximum recommended ingestion for all the months studied, the lowest value being found in September of 2010 (0.87 g/kg weight/day) when compared to the value found in May of 2010 ($p=0.001$), and was therefore closer to the recommended value.

With respect to lipids, in January of 2011 the diets carried the lowest contents of total lipids, monounsaturated FA, polyunsaturated FA and linoleic and linolenic acids, when compared to the diets served in May and September of 2010 ($p<0.05$), and the linoleic acid content did not comply with the recommendations. The mean content of the FA linolenic acid (0.4%) was below the recommended value. On the other hand,

Table I

Average (±SD) content of energy, macronutrients and trans fatty acid offered daily by renal diets oral during months January and percentage of adequacy the macronutrients in relation to the recommended nutritional for adults and elderly of both sexes

Component	*Months*			*Mean of Months ± SD*	*Parameters*
	January 2011	*May 2010*	*September 2010*		
Carbohydrate (g)	268.94 ± 39.93[a]	194.41 ± 12.01[b]	240.93 ± 19.82[a]	238.14 ± 39.86	
%	72	52	64	63.5	45 – 60*
Protein ^ (g/kg/day)	1.13 ± 0.20[a]	1.02 ± 0.02[a]	0.87 ± 0.02[a,b]	1.01 ± 0.16	0.60 -0.75**
Total lipids (g)	16.90 ± 1.71[a]	29.17 ± 9.64[b]	29.01 ± 4.23[b]	25.03 ± 8.31	
%	10	18	17.4	15	20 -35***
SFA (g)	5.81 ± 1.94	8.17 ± 3.45	8.47 ± 1.44	7.48 ± 2.62	
%	3.5	4.9	5.1	4.5	≤ 10***
MUFA (g)	4.99 ± 0.99[a]	8.48 ± 3.65[b]	7.92 ± 1.10[b]	7.13 ± 2.68	By difference
PUFA (g)	4.28 ± 2.21[a]	10.10 ± 1.51[b]	9.68 ± 2.90[b]	8.02 ± 3.48	
%	2.7	6.1	5.8	4.8	≤ 11***
Linoleic fatty acid (g)	3.30 ± 2.10[a]	9.38 ± 1.77[b]	8.92 ± 2.56[b]	7.20 ± 3.50	
%	2	5.6	5.4	4.3	2.5 – 9***
Linolenic fatty acid (g)	0.44 ± 0.29[a]	0.92 ± 0.23[b]	0.75 ± 0.30[b]	0.70 ± 0.33	
%	0.3	0.5	0.4	0.4	0.5 – 2***
Trans fatty acid (g)	0.95 ± 0.34	1.00 ± 0.47	1.40 ± 0.18	1.12 ± 0.39	
%	0.8	0.6	0.8	0.7	≤ 1***
Energy (Kcal/kg^/day)	24.94 ± 2.50[b]	20.81 ± 1.73[a]	23.89 ± 1.61[b]	23.43 ± 2.56	30 - 35**

*Brazilian Society of Diabetes, 2009; **Kidney Disease Outcomes Quality Initiative, 2002; ***Food and Agriculture Organization of the United Nations (FAO), 2010.
[a,b,c] Indicate significative difference between months
SFA= Saturated fatty acid ; MUFA=Monounsaturaed fatty acids; PUFA=Polyunsaturaed fatty acids
^ Weight corresponding to an individual 60 kg

the saturated and *trans* FA contents complied with the FAO[10] parameters (Table I).

With respect to the volume of foods carried by the diets (Table II), it can be seen that, on average, the diets carried a larger total volume in the month of January (2008g) in relation to the months of May and September, especially for the lunch and dinner meals, and the May diets presented the lowest energetic contents ($p<0.05$), as shown in table I. Nevertheless for all the study periods, the kidney diets presented a low energy density (ED) with a mean value of 0.7 kcal/g (Table II).

Discussion

The results provided evidence of the inadequacy of the carbohydrate, protein and lipid contents, as well as the low energy content of the oral hospital diets served to patients with CKD. Carbohydrate contents above the recommended values were found in the months of January (72%) and September (64%). Although the dietary fiber contents of the diets were not determined in the diets, considering the foods contained in the menus, it can be estimated that these were deficient.

An excess of carbohydrates in the diet of CKD patients was also found by Morais *et al.* (2005)[18], together with an insufficient amount of lipids (<35% of the energy value). A similar result was reported by Mafra *et al.* (2008)[19] with 64.4% of carbohydrates in the diet of chronic non-dialysis kidney patients.

According to the Kidney Disease Outcomes Quality Initiative (2002)[5], between 0.6 and 0.75 g/kg/day of protein and between 30 and 35 kcal/kg/day are ideal values for CKD sufferers under conservative treatment. In the present study, the protein content was above the recommended value, whereas the energy content was below the recommended value, with a mean offer of 23.2kcal/kg/day (Table I). Other authors have also found energy deficits in diets for CKD sufferers, varying between 20.7 and 26.2 kcal/kg/day[18-20].

Researchers reported that the protein-energy ingestion of hospitalized patients was inferior to that ingested by prison inmates, who ingested an average of 3000 kcal

Table II
Average weight of food per meal and the total daily in diets and energy density during the three months of study

Month	*Meals of renal diet- weight (g)*						*Total*	*Energy density (Kcal/g)*
	Breakfast	*Morning snack*	*Lunch*	*Snack*	*Dinner*	*Supper*		
January 2011	405	199	416	380	408	200	2008	0,7
May 2010	384	211	406	230	346	144	1721	0,7
September 2010	422	190	312	384	274	180	1762	0,8
Mean	404	200	378	331	343	175	1830	0,7

**Weight corresponding to an individual 60 kg.* [a,b,c]Indicate significative differences between months

and 100 g of protein per day, showing a difference of +1841 kcal and +55-50 g of proteins for the prison inmates[21]. Considering that the greater part of hospitalized patients consume a lower than normal volume of oral diet[22,23], the offer of a hypo-caloric diet could imply in malnutrition.

The diets studied showed a low ED, with a mean value of 0.7 kcal/g (Table II). Patients fed preparations with a low ED run the risk of ingesting an amount of energy inferior to their needs. Oliveira *et al.* (2010)[24] showed that 58.3% of the meals served in a hospital in Brasília (DF, Brazil) presented a very low ED (< 0.6 kcal/g), and none of the soft, hypocaloric and low in potassium diets, nor the milk puddings or milk-fruit shakes presented a high ED. The inclusion of more densely energetic ingredients, the preparation mode and the use of supplements could raise the ED and hence contribute to the recovery of the nutritional state of the hospitalized patients.

Although a hypo-protein diet is of concern due to its association with energy-protein malnutrition, low energy ingestion is amongst the main causes of malnutrition[5]. Quantities of protein similar to those found in the present study were reported by Mafra *et al*. (2008)[19] and Duenhas *et al*. (2003)[20], who found 0.89 and 0.98 g/kg/day of protein in the diets of non-dialysis patients, respectively. The restriction of proteins in the diets of patients under conservative treatment was one of the first objectives of the diet-therapies, aiming to overcome the progressive loss of kidney function[5], by reducing the levels of uremic toxins (urea, creatinine and uric acid)[1,4].

Importance has also been given to the protein source (animal or vegetable) with respect to kidney function. A study showed that diabetes type II patients who consumed 16 g/day texturized soy protein for 4 years, showed an improvement in their cardiovascular risk markers and also in their kidney function markers and reactive protein-C, when compared to another group on a diet without this vegetable protein. In part, the improvement in their diabetic nephropathy was attributed to the improvement in their lipid profile and glycemic control[25].

Researchers consider that the prescription of nutritional supplements, especially energy-protein ones is of benefit for the adequate nutrition of hospital patients[26]. On the other hand, the use of oral food complement could imply in a reduction in food ingestion, especially during the main meals (lunch and dinner)[23]. The use of oral nutritional supplements could be part of a strategy for nutritional protein-energy adequacy, always taking the mealtimes into consideration such that food consumption by the patient not is affected.

According to FAO (2010)[10], the total lipids should represent between 20 and 35% of the TEV, however in the present study, none of the diets complied with the minimum recommended value at any moment (Table I). The quality of the lipids in the diet is also relevant since this appears to influence the secretion and action of insulin in the human organism. According to Manco et al. (2004)[27] the polyunsaturated FA linoleic acid, and especially linolenic acid, could be potential regulators of glycemic homeostasis, since they increase the fluidity of the cell membrane and reduce the expression of the lipogenic genes. In the present study the mean value for linolenic acid in the diets (0.7g) was below the recommended minimum (0.8g).

A study involving 2600 individuals showed that those with moderate CKD presented more hypertension, hypertriglyceridemia and hypercholesterolemia as compared to healthy individuals, and that the marine or land source of the linolenic acid ingested influenced the increase or reduction in prevalence. The individuals with CKD in the quadrant for greater consumption of the FAs eicosapentanoic acid (EPA) and docosahexanoic acid (DHA) had a 31% greater probability of reducing the development of CKD when compared to individuals in the last quadrant. On the other hand, those with greater consumption of linolenic acid showed a 73% greater probability of having CKD. The difference in the origin of the linolenic acid in the prevalence of CKD appears to be due to the fact that EPA and DHA have a protective effect on kidney function due to their anti-inflammatory properties, and are also capable of preventing other diseases such as cardiovascular ones, whilst the linolenic acid from nut oils has little influence[28].

The diets examined in the present study presented adequate levels of saturated and *trans* FA, but it is worth pointing out there is no daily limit recommended for the consumption of *trans* FA. From this viewpoint, of the three points in time examined, the diet offered to the patients in May of 2010 could be considered the healthiest.

Although with limitations (e.g. the reduced number of samples, sampling in a single hospital, verification and evaluation of the offer of energy-protein supplements), the inadequacies found in the present study indicate the need for better menu planning for oral hospital diets intended for CKD sufferers. In addition, the data presented contributes to filling a void in information available concerning the lipid profile of hospital diets prescribed for patients with CKD. Knowledge of both the quantity and quality of the lipids in the diets presented to these patients has several benefits, in particular the prevention of cardiovascular diseases.

The diet profile is linked to the development of several chronic illnesses. Conversely, the most significant effects of nutrition interventions are observed among individuals with pre-existing health problems (including CKD patients), possibly reflecting their enhanced motivation to improve eating habits, and consequently improving clinical outcomes[29]. For these reasons, hospitalization time should be considered a very important phase that can be used to improve the nutritional education of the CKD patients by providing a nutritionally balanced hospital diet.

Conclusion

The oral hospital diets destined for patients with CKD presented deficits in energy and total lipids, and also in the FA linolenic acid. On the other hand, excesses of carbohydrates and proteins were also detected, with 100% of the diets considered inadequate for having passed the maximum recommended protein content. The diets elaborated for CKD sufferers were considered unbalanced and unfavorable for the nutritional care of the patients. With the aim of complying with the nutritional needs of patients with CKD and collaborating with their clinical treatment, the diets should be modified to assure the offer of essential lipids and also adequate energy, carbohydrate and protein contents. The correction of the nutritional imbalances found should be done not just due to the risk of installing malnutrition, but also because an excess of protein in the diet favors a rapid progression of the disease into the more advanced stages. The nutritional balanced hospital oral diet must be a useful tool to patient's nutritional education.

Acknowledgements

The authors are grateful to Ana Flávia L. Gontijo, Júlia S.M. de Sá and Daniele C. F. Moreira for help with sample data collection.

Funding

The authors declare that they have no conflict of interest. The study was funded by Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG, APQ 01558-09) and received support from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES - Brazil) and from Conselho Nacional de Desenvolvimento e Científico e Tecnológico (CNPq - Brazil).

References

1. Mitch WE, Remuzzi G. Diets for patients with chronic kidney disease, still worth prescribing. *J Am Soc Nephrol* 2004; 15:234-7.
2. Castillo RF, Gallegos RF, Esteban de la Rosa, RJ, Amaro PP. Estudio longitudinal del peso e índice de masa corporal tras en el trasplante renal durante 5 años de evolución. *Nutr Hosp* 2014; 30:75-84.
3. Toigo G, Aparicio M, Attman P-O, Cano N, Cianciaruso B, Engel B, et al. (2000) Expert working group report on nutrition in adult patients with renal insufficiency (part 1 of 2). *Clin Nutr* 2000; 19:197–207.
4. Cianciaruso B, Pota A, Pisani A, Torraca S, Annecchini R, Lombardi P, et al. Metabolic effects of two low protein diets in chronic kidney disease stage 4–5; a randomized controlled trial. *Nephrol Dial Tansplant* 2008; 23:636-44.
5. Kidney Disease Outcomes Quality Initiative. Clinical Practice Guidelines for Chronic Kidney Disease: Evaluation, Classification and Stratification. *Am J Kidney Dis* 2002; 39:1-266.
6. Chen J, Muntner P, Hamm LL, Fonseca V, Batuman V, Whelton PK, et al. Insulin resistance and risk of chronic kidney disease in nondiabetic US adults. *J Am Soc Nephrol* 2003; 14:469-77.
7. Landecho MF, Colina I, Huerta A, Fortuño A, Zalba G, Beloqui O. Relación entre las fases precoces de la enfermedad renal y el síndrome metabólico. *Rev Esp Cardiol* 2011; 64 373-8.
8. Voormolen N, Noordzij M, Grootendorst DC, Beetz I, Sijpkens YW, van Manen JG, et al. High plasma phosphate as a risk factor for decline in renal function and mortality in pre-dialysis patients. *Nephrol Dial Transplant* 2007; 22:2909-16.
9. Schwingshackl L, Hoffmann G. Comparison of effects of long-term low-fat *vs* high-fat diets on blood lipid levels in overweight or obese patients: a systematic review and meta-analysis. *J Acad Nutr Diet* 2013; 113:1640-61.
10. Food Agriculture Organization of the United Nations (FAO). Fats and fatty acids in human nutrition. Report of an expert consultation. Rome: Italy; 2010. (Acessed Dec 05, 2013, < http://www.fao.org/docrep/013/i1953e/i1953e00.pdf>).
11. Horwitz W. Official Methods of Analysis of the Association of Official Analytical Chemists. 18th ed. Gaithersburg, Maryland: AOAC; 2010.
12. Instituto Adolfo Lutz. Métodos físico-químicos para análise de alimentos. 4th ed. Brasília: Ministério da Saúde; 2005.
13. Hartman L, Lago RA. Rapid preparation of fatty acid methyl esters from lipids. *Lab Pract* 1973; 22:475-81.
14. Food and Agriculture Organization of the United Nations (FAO). Food energy – methods of analysis and conversion factors. Report of a technical workshop. Rome: Italy; 2003. (Accessed Dec 05, 2013, <ftp://ftp.fao.org/docrep/fao/006/y5022e/y5022e00.pdf>).
15. Center of Disease Control and Prevention. Can eating fruits and vegetables help people to manage their weight? *Res Pract Series* 2005; 1:1-6.
16. Institute of Medicine. Dietary reference intakes: recommended intakes for individuals, Washington, DC: National Academy Press; 2002.
17. Diretriz Brasileira de Diabetes 2009. São Paulo, SP: Sociedade Brasileira de Diabetes (Accessed Aug 10, 2013,< http:// www.diabetes.org.br>).
18. Morais AAC, Silva MAT, Faintuch J, Vigidal EJ, Costa RA, Lyrio DC. Correlation of nutritional status and food intake in hemodialysis patients. *Clinics* 2005; 60:185-92.

19. Mafra D, Fávaro DIT, Fouque D, Cozzolino SMF. Determination of trace elements in the diet of non-dialyzed renal patients. *Nutrire* 2008; 33:61-72.
20. Duenhas MR, Draibe SA, Avessani CM, Sesso R, Cuppari L. Influence of renal function on spontaneous dietary intake and on nutritional status of chronic renal insufficiency patients. *Eur. J. Clin. Nutr.* 2003; 57:1473-8.
21. Johns N, Edwards JSA, Hartwell HJ. Hungry in hospital, well-fed in prison? A comparative analysis of food service systems. *Appetite* 2013; 68:45-50.
22. Rasmussen HH, Kondrup J, Staun M, Ladefoged K, Lindorff K, Jørgensen LM, et al. A method for implementation of nutritional therapy in hospitals. Clin. *Nutr.* 2006; 25:515-23.
23. Sá JSM, Moreira DCF, Louvera Silva KA, Morgano MA, Quintaes KD. Consumption of oral hospital diets and percent adequacy of minerals in oncology patients as an indicative for the use of oral supplements. *Clin Nutr* 2014; 33:655-61.
24. Oliveira CS, Reis CS, Miranda TS, Akutsu RC, Savio KE, Botelho, R.E.A. (2010) Análise da densidade energética de preparações servidas em uma unidade de nutrição e dietética. *Nutrire* 35 77-86.
25. Azadbakht L, Atabak S, Esmaillzadeh A. Soy Protein Intake, cardiorenal indices, and C-reactive protein in type 2 diabetes with nephropathy. *Diab Care* 2008; 31:648-54.
26. Hubbard GP, Elia M, Holdoway A, Stratton RJ. A systematic review of compliance to oral nutritional supplements. *Clin Nutr* 2012; 31:293-312.
27. Manco M, Calvani M, Mingrone G. Effects of dietary fatty acids on insulin sensitivity and secretion. *Diab Obesity Metab* 2004; 6:402-13.
28. Gopinath B, Harris DC, Flood VM, Burlutsky G, Mitchell P. Consumption of long-chain n-3 PUFA, a-linolenic acid and fish is associated with the prevalence of chronic kidney disease. *Br J Nutr* 2011; 105:1361-68.
29. Brito-Ashurst I, Perry L, Sanders TAB, Thomas JE, Dobbies H, Yaqoob MM. Applying research in nutrition education planning: a dietary intervention for Bangladeshi chronic kidney disease patients. *J Hum Nutr Diet* 2013; 26:403-13.