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Artigo

MINERAL AND VITAMIN CONTENT OF BEEF, CHICKEN, AND TURKEY HYDROLYSATES
MINERAL AND VITAMIN CONTENT OF PROTEIN HYDROLYSATES

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The purpose of this study was to assess the concentration of vitamins and minerals in meat protein hydrolysates. Calcium, phosphorus and iron were analyzed by inductively coupled-plasma atomic emission spectrophotometry; vitamin C was analyzed by the reduction of cupric ions and vitamins B1 and B2 by fluorescence. Regarding minerals, the beef hydrolysate (BH) had more iron than the turkey hydrolysate (TH) and the chicken hydrolysate (CH); TH had a little more phosphorus. BH had the largest amount of vitamin C, and similar amounts of vitamins B1 and B2. The amount of these nutrients found in the hydrolysates suggests that it is possible to use them to enrich special dietary formulations.

Keywords: protein hydrolysates of meat; minerals; vitamins.

INTRODUCTION

Research on modified ingredients has been undertaken in order to improve adherence to special diets. These modified ingredients are obtained industrially or at home. Special emphasis is given to protein hydrolysates used in dietary formulations or food products. Protein hydrolysates are used to enrich foods with sources of high biological value protein, facilitate protein absorption and improve technological function[1].

Protein hydrolysates have been used in the nutritional treatment of individuals with impaired digestion of intact protein[2], for instance in cases of decreased luminal hydrolysis, reduced absorptive capacity, gastric or hepatic failure[3], malnutrition associated with cancer, metabolic dysfunctions, and food allergies[4]. Hydrolysates have been used to improve food texture and fortify drinks, as well as in infant formulas and nutritional products[5,6].

The existing technological resources in the field of nutrition do not ensure that patients will follow special diets adequately. Hydrolysates contribute to facilitate homemade food preparation, increase adherence to prescribed diets and reduce preparation cost.

Homemade formulas are prepared from fresh food that is either processed in blenders or prepared manually in domestic or hospital kitchens. Commercial formulas are prepared industrially and packed in hermetically closed packages or cans[7].

Stabile[8] determined the optimal conditions for the hydrolysis of beef protein using natural pineapple juice (meat/juice1:1), and obtained the following values: temperature of 66.8 °C, pH of 6.4, enzymatic activity of 175.94 µg/mL min, and soluble solids concentration of 7.6 g/100 g. The amount of soluble solids observed by the author was higher than that obtained with the isolated and purified enzyme. Another study conducted by the same researcher showed that homemade formulas prepared from beef, chicken and turkey were similar to commercial formulas prepared from soy and egg in terms of energy content, nutritional composition, and osmolarity. Moreover, the lower cost of beef, chicken and turkey hydrolysates compared with casein hydrolysates used in enteral formulas suggests that they be used in special diets, dietary supplements and enteral feeding.

Many hospital nutrition services are developing simple, daily use formulas that outpatients can easily prepare, thus ensuring continuation of the diet and consequent improvement of their nutritional status. The preparation of these diets is not always the result of a simple adaptation. It is necessary to know which interactions may occur between different foods, and how to avoid or mask those interactions in order to improve acceptability. Pinto e Silva *et al.*[9] prepared hydrolysates under conditions similar to home preparation, and observed good acceptance levels by means of sensory analysis.

Considering that hydrolysates proved effective in different pathological conditions that require special diets, the use of industrial or homemade hydrolysates must be expanded and adapted to suit the needs and environment of different patients.

Yet the lack of data on the composition of foods and formulas commonly consumed by the population compromises the evaluation of special diets, which therefore justifies the evaluation of nutrient levels in hydrolysates.

The purpose of this study was to determine the amount of vitamins and minerals in hydrolysates of beef, chicken and turkey in order to complement the composition of menus and guarantee the quality of the diet.

EXPERIMENTAL

Material

Commercial cuts of beef such as "coxão mole" (slab of muscles from the inner side of the legs of cattle), turkey breast and chicken breast were used. Fresh ripe pineapple juice from the Hawaii and Pearl varieties (Ananas comosus L.) was used as a source of bromelain, the proteolytic enzyme obtained from pineapples.

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Table 1. Mineral and vitamin content (average ± standard deviation) of meat hydrolysates

Hydrolysate	Iron (mg/100 g)	Phosphorus (mg/100 g)	Calcium (mg/100 g)	Vitamin B1 (mg/100 g)	Vitamin B2 (mg/100 g)	Vitamin C (mg/100 g)
Turkey	0.43 ± 0.03	137.00 ± 3.60	10.30 ± 1.50	0.08 ± 0.00	0.08 ± 0.00	42.60 ± 1.30
Chicken	0.36 ± 0.01	125.00 ± 0.50	7.50 ± 0.03	0.07 ± 0.00	0.08 ± 0.00	47.50 ± 2.80
Beef	1.50 ± 0.28	124.00 ± 1.27	8.20 ± 2.12	0.08 ± 0.01	0.09 ± 0.00	54.80 ± 0.55

n = 9.

The meat (three different lots of each type) was acquired refrigerated.

Obtaining the hydrolysate

The hydrolysate was obtained by using equal volumes of ground meat and fresh pineapple juice (1:1) in a 250 mL container. The meat and the juice were blended and kept in a double boiler (60 ºC) for 30 min using a domestic stove. Subsequently, the mixture was boiled for five minutes, and sifted to remove insoluble residues using the method devised by Pinto e Silva *et al.*[10], which was adapted from Stabile's method[8]. The hydrolysates were prepared under conditions similar to household manipulation at the laboratory of Dietary Techniques of the Department of Nutrition, School of Public Health, University of São Paulo.

Mineral analysis

For the analysis of minerals, the samples were initially homogenized in a food processor and dried in a drying oven at 100 °C. The samples were then burned and oven-dried at 450 °C to constant weight. Inductively coupled plasma-atomic emission spectrometry (ICP-AES) was used to determine the calcium, iron and phosphorus contents. A Spectrometer (Optima 3000 DV, Perkin Elmer – 1350 W) was used with the following wavelengths: 422.673 nm for calcium; 213.618 nm for phosphorus and 259.940 nm for iron. The limit of quantification (LOQ) was 0.003 mg/kg for calcium; 0.04 mg/kg for phosphorus; and 0.003 mg/kg for iron. The limits of quantification were determined according to the recommendations of IUPAC[11].

Vitamin analysis

Vitamin B1 was determined by oxidation to thiochrome, according to the Analytical Methods of the Adolfo Lutz Institute[12]. The vitamin reacts in aqueous solution with a solution of potassium ferrocyanide in a strongly alkaline medium.

Vitamin B2 was determined by fluorometry, using a fluorescein solution, according to the Analytical Methods of the Adolfo Lutz Institute[12].

The analytical method for determining the ascorbic acid (vitamin C) content was described by Contreras-Guzman *et al.*[13] and was based on the reduction of cupric ions.

The values obtained after laboratory analysis were compared to the Brazilian Food Composition Table[14,15].

Osmolarity

Osmolarity was determined by cryoscopy[16] using an osmometer (Advanced Wide-Range Osmometer 3W2) at the Nephrology Laboratory-HCFMUSP.

The results are presented as mean values and standard deviations. Each sample was analyzed at three different moments over the year, considering the variability of the foods (n = 9). The statistical analysis was based on the mean value of the results obtained at these three moments.

RESULTS AND DISCUSSION

Table 1 presents the values of minerals and vitamins obtained for the three protein hydrolysates. The beef hydrolysate contained three times as much iron as the turkey or chicken hydrolysate, which can be explained by the myoglobin concentration. The concentration of myoglobin and the amounts of heme iron and non-heme iron vary between species, as showed by Purchas *et al.*[17], and are always higher in beef. The amounts of iron obtained were compared to the values of iron for pineapple juice and lean meats given by the Brazilian Food Composition Table[14,15] and there was no loss of this mineral in the hydrolysates. The iron found in meats has good bioavailability, that is, it is present in the right form to be absorbed by the human body[18]. Every 100 g of beef, turkey or chicken hydrolysate provides, respectively, 18.8, 5.3 and 4.5% of the dietary reference intake of iron[19].

The turkey hydrolysate contained the highest amounts of phosphorus (137.0 mg/100 g) and calcium (10.3 mg/g). The minerals analyzed are not very susceptible to loss during heating processes, but they may bind to other elements during cooking and become difficult to detect by the method used. The turkey hydrolysate provides 19.6% of the dietary reference intake of phosphorus and 1.03% of the recommended daily intake of calcium. The amount of phosphorus found in both the beef and chicken hydrolysates provides at least 17% of the dietary reference intake. With regard to calcium, the consumption of 100 g of beef, chicken or turkey hydrolysate provides 0.82, 0.75 and 1.0% of the dietary reference intake, respectively[19].

With regard to vitamins, the beef hydrolysate contained the largest amount of vitamin C (54.8 mg/100 g), and similar amounts of vitamins B1 and B2 (0.08 mg/100 g). Although beef contains small amounts of vitamin B, it is considered a source of this vitamin. Vitamin B was not lost during hydrolysis process, which can be confirmed by comparing the values obtained to the Brazilian Food Composition Table. The vitamin C present in the hydrolysate comes from the fresh pineapple juice, and was preserved despite the heating process. This amount corresponds to about 88% of the theoretical total[15] (61 mg/100 g) and meets at least 63% of the dietary reference intake(DRI) for a healthy adult[19].

All the vitamins analyzed can contribute to the improvement of the quality of the diet, even when present in small amounts. The greatest loss observed was for vitamin B2. The consumption of 100 g of beef, chicken or turkey hydrolysate provides, respectively, 8.0, 7.0 and 8.0% of the dietary reference intake of vitamin B1. With regard to vitamin B2, the consumption of 100 g of any of the hydrolysates mentioned above provides at least 7.0% of the recommended daily intake[19].

The nutrients whose values differed the most from those in the Brazilian Food Composition Table[14,15] were calcium, vitamin B2

and vitamin C. The values for calcium obtained upon analysis were 50% lower than those found in the Table. On the other hand, the values obtained for vitamin B2 and vitamin C were higher than those found in the Brazilian Food Composition Table.

Differences between the analyzed values and those found in the Brazilian Food Composition Table – verified in other studies as well[20] – may be the result of different methods of analysis employed and/or loss of nutrients.

According to the standard deviations obtained, no significant difference was observed between the three different lots of each type of meat with regard to the nutrient content.

With regard to osmolarity, hydrolysates were classified as highly hypertonic, as shown in Table 2. Nevertheless, they did not negatively influence the nutrient values of the formulas when associated with other diet components. Although meat is controlled by federal institutions, which aim at ensuring its homogeneity from production to commercialization, the samples of beef showed variation in mineral content (Table 1).

Table 2. Osmolarity of the hydrolysates

Hydrolysate	Osmolarity (mOsm/Kg)
Turkey	843.00 ± 1.40
Chicken	868.00 ± 1.40
Beef	761.50 ± 2.12

n = 9

These nutrient composition data may help to establish parameters to assess the presence or absence of nutrients in homemade products, considering how scarce this kind of information is[21].

The knowledge of the vitamin and mineral contents in foods after their processing is desirable, taking into account that the losses of nutrients may be either over- or underestimated. This information may facilitate the planning of and adherence to an adequate diet. In addition, guidelines on food preparation techniques may aid in the recovery and/or maintenance of a patient's nutritional status.

REFERENCES

1. Morato, A. F.; Carreira, R. L.; Junqueira, R. G.; Silvestre, M. P. C.; *J. Food Comp. Anal.* **2000***, 13*, 843.
2. Chiang, W. D.; Shih, C. J.; Chu, Y. H.; *Food Chem*. **1999**, *65*, 189.
3. Clemente, A.; *Trends Food Sci. Technol*. **2000**, *11*, 254.
4. Neves, R. A. M.; Mira, N. V. M.; Marquez, U. M. L.; *Cienc. Tecnol. Aliment*. **2004**, *24*, 101.
5. Mahmoud, M. I.; *Food Technol.* **1994***, 48*, 89.
6. Chiang, W. D.; Cordle, C. T.; Thomas, R. L.; *J. Food Sci*. **1995**, *60*, 1349.
7. Baxter, Y. C.; Waitzberg, D. L.; Rodrigues, J. J. G.; Pinotti, H. W. Em *Nutrição oral, enteral e parenteral na prática clínica;* Waitzberg, D. L., ed.; Atheneu: São Paulo, 2001, cap. 41.
8. Stabile, M. N. O.; *Tese de Doutorado*, Universidade de São Paulo, Brasil, 1991.
9. Pinto e Silva, M. E. M.; Mazzilli, R. N.; Barbieri, D.; *J. Pedia.* **1998***, 74*, 217.
10. Pinto e Silva, M. E. M.; Mazzilli, R.; Cusin, F.; *J. Food Comp. Anal.* **1999***, 12*, 219.
11. Currie, L. A.; *Pure Appl. Chem.* **1995**, *67*, 1667.
12. Instituto Adolfo Lutz; *Normas Analíticas do Instituto Adolfo Lutz: Métodos químicos e físicos para análises de alimentos,* Instituto Adolfo Lutz: São Paulo, 1985.
13. Contreras-Guzman, E. S.; Strong III, F. C.; Guernelli, O.; *Quim. Nova* **1984***, 7*, 60.
14. Universidade Estadual de Campinas, Núcleo de Estudos e Pesquisa em Alimentação; *Tabela Brasileira de Composição de Alimentos*, Campinas, 2006.
15. Fundação Instituto Brasileiro de Geografia e Estatística; *Tabelas de composição de alimentos,* IBGE: Rio de Janeiro, 1999.
16. Vargas, J. J.; Macarulla, J. M.; *Físico-química fisiologica*, Reverté: Madri, 1971.
17. Purchas, R. W.; Simcock, D. C.; Knight, T. W.; Wilkinson, B. H. P.; *Int. J. Food Sci. Technol*. **2003**, *38,* 827.
18. Uzel, C.; Conrad, M. E.; *Seminar Hematol*. **1998**, *35*, 27.
19. NRC - National Research Council; *Dietary Reference Intake: applications in dietary assessment*, National Academic Press: Washington, 2000.
20. Mitne, C.; Simões, A. M. G.; Wakamoto, D.; Liori, G. P.; Sullivan, M.; Comer, G. M.; *Rev. Bras. Nutr. Clin.* **2001**, *16,* 100.
21. Torelm, I.; Danielsson, R.; Appelqvist, L. A.; Bruce, A.; *J. Food Comp. Anal*. **1997**, *10*, 14.