Methionine and Cystine in Puerto Rican Institutional Dishes

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INTRODUCTION AND OBJECTIVE

The basic Puerto Rican diet is known to be low in methionine and cystine. It consists principally of starchy vegetables, polished rice, beans (red kidney and navy beans principally), small portions of codfish and still less of other minor constituents.

Cook, Axtmayer, and Dalmau (*1*)[2] reported that some growth improvement took place when rats were fed this diet supplemented with cystine. Axtmayer (*2*) showed that the growth of rats fed a rice-and-bean diet was dramatically improved when supplemented with small amounts of methionine. Asenjo and Goyco (*3*) confirmed this observation. Recently, Goyco (*4*) reported significant improvement in the nitrogen balance of human volunteers kept exclusively on the Puerto Rican basic diet when this was supplemented with methionine.

The purpose of the present investigation was to determine the methionine and cystine contents of dishes commonly served at the Cafeteria of the School of Medicine of the University of Puerto Rico.

MATERIALS AND METHODS

All the dishes studied were cooked at the Cafeteria of the School of Medicine under the care of graduate dietitians according to accepted methods. At least three different samples of each dish were assayed. All determinations were made in duplicate.

Moisture was determined by heating the samples at 100° C. to constant weight. Nitrogen was determined according to the official semimicro Kjeldahl method of the Official Methods of Analysis of the AOAC (*5*), although using a smaller sample than the one recommended, and selenized Hengar granules as catalyst. Methionine was assayed by the microbiological method of Stokes, *et al.* (*6*), using *Streptococcus fecalis* (*S. Lactis* R.).

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[2] Italic numbers in parentheses refer to Literature Cited, p. 359.

Cystine was assayed following essentially the microbiological method of Barton-Wright (*7*), although the sample was hydrolyzed in the autoclave at 15 lb. pressure for a period of 2 hours only, as recommended by Horn and Blum (*8*). Difco's dehydrated medium for cystine was used as the basal medium and *Leuconostoc mesenteroides* P 60, as the test organism.

All the organisms used in these assays were obtained from the American Type Culture Collections in Washington, D.C.

RESULTS AND DISCUSSION

The results are reported in table 1. In the following discussion all values for methionine and cystine are reported on the basis of the dish as served.

The dishes composed mainly of animal proteins were the ones with the highest content of methionine and cystine. Thus the highest methionine content was exhibited by stuffed meat and stewed goat, 876.1 and 829.0 mg. per 100 gm. as served, respectively. Both of these dishes were also high in cystine, 191.0 and 125.8 mg. per 100 gm., respectively. The meat dish with the lowest methionine and cystine content was entrails of chicken, 251.9 mg. of methionine per 100 gm. and 55.7 mg. of cystine per 100 gm. The meat dish with the highest cystine content was roasted thigh of pork with 291.0 mg. per 100 gm. This dish was also high in methionine with 778.8 mg. per 100 gm. The only fish dish tested, breaded perch, had a high methionine content but a rather low cystine when compared with meat dishes.

The dishes with the lowest content of both methionine and cystine are those composed exclusively of vegetables. Boiled arracacha was the dish with the lowest content of methionine, 5.5 mg. per 100 gm., and cystine 0.9 mg. per 100 gm. It is interesting to note that root-crop dishes in general had a higher content of cystine than the other vegetable dishes. Boiled yellow tanier had the highest cystine values, 21.6 mg. per 100 gm., among the vegetable dishes.

Among the socalled cereal foods the different breads assayed showed the highest content of methionine and cystine. Methionine was over 130 mg. per 100 gm. and cystine over 120 mg. per 100 gm. As bread is eaten in appreciable quantity it contributes a substantial amount of these two amino acids to the daily diet.

Beans, in general, were relatively low in methionine and cystine, ranging from 44.7 to 36.8 mg. per 100 gm. and from 13.8 to 7.4 mg. per 100 gm., respectively.

The majority of the desserts ranged in methionine between 85.7 and 24.0 mg. per 100 gm. and in cystine between 35.8 and 13.7 mg. per 100 gm. Two desserts that rated well above the rest, probably because they con-

TABLE 1.—*Methionine and cystine in Puerto Rican institutional dishes*

Name of dish in English	Name of dish in Spanish	Method of cooking	Samples tested	Moisture	Protein, wet basis	Methionine per 100 gm. as served: Average maximum and minimum in parentheses	Cystine per 100 gm. as served: Average maximum and minimum in parentheses
			Number	*Percent*	*Percent*	*Milligrams*	*Milligrams*
Vegetables:							
Arracacha	Apio	Boiled	3	69.6	1.0	5.5 (8.5–3.6)	0.9 (1.1–0.8)
Banana, green	Guineo verde	do.	3	74.6	1.2	11.4 (13.5–9.1)	2.5 (3.1–2.1)
Cabbage	Repollo	do.	3	85.1	1.4	16.5 (21.0–14.0)	4.0 (4.1–3.8)
Carrots, boiled	Zanahorias hervidas	Boiled; butter added	3	86.3	0.8	8.5 (10.3–7.3)	1.0 (1.0–1.0)
Carrot and raisin salad	Ensalada de zanahorias y pasas	Raw	3	71.1	1.4	7.5 (11.0–5.8)	2.1 (2.3–2.0)
Corn, cream style	Maíz a la crema	Cream style	3	76.1	2.1	52.6 (56.4–46.4)	6.3 (6.7–5.7)
Corn and lima beans	Maíz y habas	Boiled; butter added	3	69.0	4.4	68.5 (73.2–62.9)	13.8 (15.7–11.6)
Corn, whole kernel	Maíz en grano	do.	3	65.5	3.0	71.8 (80.7–65.2)	13.2 (13.9–12.5)
Mixed vegetables	Vegetales mixtos	do.	3	82.3	2.9	41.6 (45.3–38.2)	12.8 (14.9–10.7)
Peas and carrots	Guisantes y zanahorias	do.	3	79.9	3.4	29.9 (38.4–19.9)	8.4 (8.7–8.0)
Plantain, green	Plátano verde	Boiled	3	64.4	0.9	8.9 (9.3–8.2)	2.0 (2.2–1.7)
Plantain, yellow, baked	Plátano amarillo al horno	Baked	3	57.1	0.7	9.4 (10.3–9.0)	2.2 (2.5–1.8)

Potatoes, cream style	Papas en salsa blanca	Cream style	3	81.3	2.4	26.2 (32.7–16.3)	5.6 (6.5–4.8)
Potatoes, fried	Papa frita	Fried	3	63.6	3.3	32.0 (52.4–21.5)	6.7 (8.6–5.8)
Potatoes, mashed	Papa majada	Mashed	3	74.0	2.3	33.5 (41.1–25.5)	7.7 (8.2–7.3)
Potato salad with eggs	Ensalada de papas con huevos	Boiled potatoes and eggs	3	75.9	2.7	65.1 (83.4–45.8)	7.6 (8.3–6.9)
Puerto Rican sweetpotato, glazed	Batata mameya, glacé	Glazed	3	41.8	1.0	25.0 (26.8–22.1)	2.4 (3.2–1.9)
Pumpkin, boiled	Calabaza hervida	Boiled	3	86.6	0.9	6.8 (7.4–6.2)	1.5 (1.5–1.4)
Pumpkin, mashed	Calabaza majada	Mashed	3	86.4	1.2	15.6 (16.0–15.2)	2.0 (2.6–1.5)
Spinach, boiled	Espinaca hervida	Boiled; butter added	3	91.7	2.1	24.4 (25.9–23.5)	6.0 (6.1–5.8)
Sweetpotato, white, boiled	Batata blanca hervida	Boiled	3	61.3	0.8	13.9 (17.8–10.4)	2.5 (3.0–2.1)
Tanier, white, boiled	Yautía blanca hervida	do.	3	67.5	2.2	21.1 (25.0–18.2)	13.2 (14.4–12.6)
Tanier, yellow, boiled	Yautía amarilla hervida	do.	3	68.3	1.7	17.4 (20.3–15.5)	21.6 (23.6–20.4)
"Tostones" of plantain	Tostones de plátano	Fried	3	32.0	1.4	15.6 (17.0–12.9)	5.6 (6.7–4.8)
Yam, white, boiled	Ñame hervido	Boiled	3	70.5	1.5	19.8 (23.3–13.6)	3.7 (4.4–2.8)
Meats:							
Beef steak, baked	Beef steak al horno	Baked	3	63.4	21.7	589.3 (677.1–528.5)	107.0 (133.8–92.0)
Chicken, baked	Pollo al horno	do.	3	65.3	19.2	444.9 (576.4–325.8)	83.1 (109.8–66.7)

TABLE 1.—*Continued*

Name of dish in English	Name of dish in Spanish	Method of cooking	Samples tested	Moisture	Protein, wet basis	Methionine per 100 gm. as served: Average maximum and minimum in parentheses	Cystine per 100 gm. as served: Average maximum and minimum in parentheses
			Number	*Percent*	*Percent*	*Milligrams*	*Milligrams*
Entrails of chicken	Menudos de pollo	Stewed	3	67.7	13.8	251.9 (312.3–132.8)	55.7 (63.1–51.6)
Goat, fricassee	Cabro en fricasé	do.	3	63.7	22.0	495.9 (619.3–388.1)	112.7 (150.0–70.7)
Goat, stewed	Cabro estofado	do.	3	59.1	27.3	829.0 (907.6–777.1)	125.8 (155.3–93.4)
Hamburger	Hamburguesa	Fried	3	46.5	17.8	430.1 (453.7–385.7)	148.5 (169.0–111.7)
Hot dogs, stuffed	"Hot dogs" rellenos	Stuffed with cheese and bacon	3	42.8	20.8	395.3 (413.6–362.6)	100.0 (110.7–91.7)
Ham in wine	Jamón en vino	In wine sauce	3	44.8	14.3	319.1 (396.9–277.1)	65.4 (75.1–59.7)
Meat, breaded	Carne empanada	Fried	3	49.9	19.5	512.0 (587.7–461.4)	104.7 (115.4–96.8)
Meat, stuffed	Carne mechada	Stewed	3	53.2	32.8	876.1 (998.7–631.8)	191.0 (251.6–121.3)
Meat, stewed	Carne guisada	do.	3	63.7	17.1	334.3 (418.9–236.7)	81.1 (96.4–53.7)
Pork, thigh	Pernil de cerdo	Roasted	3	51.2	30.2	778.8 (854.0–659.3)	291.0 (327.7–226.4)
Veal stew	Ternera estofada	Stewed	3	72.1	16.0	375.0 (420.5–343.2)	87.1 (95.6–82.4)
Veal roast	Ternera al horno	Roasted	3	67.5	26.1	796.9 (930.5–541.8)	154.4 (176.9–114.8)

Meat mixtures:							
"Asopao" of chicken	Asopao de pollo	Condiment slightly fried; chicken, rice and tomato sauce added, cooked until done but soupy	3	84.0	4.5	124.3 (167.8–102.2)	17.2 (20.5–14.4)
Chicken salad	Ensalada de pollo	Boiled chicken, eggs and potatoes	3	72.4	6.4	131.4 (185.5–94.1)	26.0 (35.5–14.1)
Chili con carne	Chile con carne	Stewed	3	71.5	7.5	120.0 (160.7–74.1)	23.6 (28.1–19.3)
"Hayacas"	Hayacas	Boiled	3	69.8	6.8	166.4 (180.9–147.1)	38.0 (39.0–36.3)
"Pasteles"	Pasteles	do.	3	70.0	5.1	98.1 (125.4–65.4)	19.6 (21.3–14.9)
"Pastelón de yautía"	Pastelón de yautía	Baked	3	65.1	7.7	167.9 (203.8–116.2)	51.3 (52.9–49.6)
Rice with chicken	Arroz con pollo	The same as "Asopao" of chicken but cooked until all water evaporates.	3	48.5	12.9	258.0 (330.6–211.2)	35.6 (36.6–34.6)
Turkey chow mein	Chow mein de pavo	Stewed	3	71.0	7.6	140.4 (166.2–124.7)	38.3 (44.8–34.3)
Sea Foods:							
Fish, breaded	Pescado empanado	Fried	3	46.0	24.7	706.3 (726.8–669.6)	87.0 (90.9–80.3)
Lobster salad	Ensalada de langosta	Lobster, potatoes and eggs are cooked; other ingredients are as available	3	73.7	11.0	297.5 (386.3–226.4)	62.2 (85.7–46.5)
Cereals:							
"Asopao" of pigeonpeas	Asopao de gandules	The same as "asopao" of chicken but without chicken and with pigeonpeas	3	86.4	1.6	24.3 (26.9–19.3)	5.2 (6.1–4.4)

TABLE 1.—*Concluded*

Name of dish in English	Name of dish in Spanish	Method of cooking	Samples tested	Moisture	Protein, wet basis	Methionine per 100 gm. as served: Average maximum and minimum in parentheses	Cystine per 100 gm. as served: Average maximum and minimum in parentheses
			Number	*Percent*	*Percent*	*Milligrams*	*Milligrams*
Bread, French	Pan francés	Baked	3	26.1	11.4	172.9 (179.6–158.9)	143.4 (151.6–134.4)
Bread, sandwich	Pan especial	do.	3	33.5	9.1	152.3 (157.6–148.3)	124.5 (128.5–118.7)
Rice, white	Arroz blanco	Rice cooked with lard, salt, and water until water evaporates	3	47.5	2.7	64.6 (66.7–63.0)	17.2 (18.4–16.3)
Rice with pigeonpeas	Arroz con gandules	The same as rice, white, but with pigeonpeas	4	60.2	3.1	50.5 (54.9–48.2)	16.2 (19.0–15.0)
Spaghetti with pork	Spaghetti con cerdo	Spaghetti boiled; sauce contains ground pork meat, tomato and other ingredients; water added, cooked until sauce thickens	3	69.8	5.2	85.2 (108.4–55.9)	28.9 (32.4–25.8)
Beans:							
Chick peas	Garbanzos	Stewed	3	77.4	3.7	44.7 (53.8–42.9)	13.8 (15.5–10.6)
Navy beans	Habichuelas blancas	do.	3	79.8	3.8	36.8 (44.6–21.2)	8.3 (10.5–6.8)
Pigeonpeas	Gandules	do.	3	77.9	3.3	39.8 (46.6–36.0)	9.1 (10.2–8.0)
Red kidney beans	Habichuelas coloradas	do.	3	79.5	3.6	38.5 (44.5–33.8)	7.4 (7.9–7.2)

Desserts:							
Apple pie	Pastel de manzana	Baked	3	53.0	2.1	24.0 (26.3–18.8)	13.7 (15.7–12.3)
Banana cake	Bizcocho de guineo	do.	3	22.8	3.9	85.7 (105.0–71.0)	33.0 (33.6–32.6)
"Besito" of coconut	Besito de coco	do.	3	17.4	3.3	85.9 (102.4–54.5)	35.8 (40.9–26.4)
Coconut pie	Pastel de coco	do.	3	44.2	3.8	69.2 (85.4–60.8)	24.4 (27.0–20.6)
Cream puff	Palito de Jacob	do.	3	55.8	5.0	142.3 (159.6–127.3)	42.3 (46.6–38.9)
Icebox cake	Bizcocho de nevera	Refrigerated	3	34.4	2.3	55.8 (57.1–53.8)	14.3 (15.0–13.3)
Jellyroll	Brazo gitano	Baked	3	15.1	4.3	113.8 (144.3–91.7)	33.8 (37.1–29.2)
"Mantecadito"	Mantecadito	do.	3	34.1	3.4	53.4 (59.3–44.8)	31.7 (34.7–28.1)
Oatmeal and raisin cookie	Galleta de avena y pasas	do.	3	14.0	4.7	72.2 (74.0–70.5)	24.4 (24.9–24.1)
Pumpkin "pudín"	Pudín de calabaza	do.	3	54.1	3.7	96.4 (109.7–84.9)	14.6 (19.4–7.5)
Upside-down cake	Bizcocho al revés	do.	3	34.0	2.6	41.6 (46.9–37.6)	18.3 (21.5–14.3)
Royal yolks	Yemas reales	do.	3	34.6	2.7	75.2 (125.6–38.6)	21.3 (28.6–17.0)

tained considerable egg, milk, and flour, were cream puff and jellyroll with 142.3 and 113.8 mg. per 100 gm. of methionine and 42.3 and 33.8 of cystine mg. per 100 gm., respectively.

On a cystine-free diet Rose (*9*) set 2.2 gm. of methionine per day as the definite safe value. In order to determine the nutritional adequacy of any food for methionine one must know its cystine content as, according to Rose (*10*), 80 to 89 percent of the methionine requirement in man can be met by cystine.

As the School Cafeteria serves lunches only, we have calculated out the methionine and cystine contents of two typical lunches. One lunch consisted of standard servings of a vegetable, meat, cereal, and salad dish, plus a dessert, but with the dish in each one of these categories having the lowest methionine-cystine content. At the other extreme we used a lunch menu comprising dishes in each of the above categories containing the highest content of methionine-cystine. The low methionine-cystine lunch menu was as follows: Sandwich bread, boiled arracacha, stewed entrails of chicken, "asopao" of pigeonpeas, carrot and raisin salad, and apple pie. The standard servings contributed 0.66 gm. of methionine and 0.15 gm. of cystine, that is, a total of 0.81 gm. of methionine-cystine. The high methionine-cystine luncheon consisted of the following dishes: French bread, whole-kernel corn, stuffed meat, rice with chicken, and cream puff. The standard servings contributed 1.61 gm. of methionine and 0.35 gm. of cystine, that is, 1.96 gm. of methionine-cystine. Therefore, both menus supplied the recommended intake of about 0.4 gm. of methionine per day that cannot be replaced with cystine. However, neither one provided in its entirety the remaining 1.8 gm., either as methionine or as cystine. According to these estimates, it can be stated that any lunch menu served in the cafeteria, if fully consumed, supplies anywhere between 36 and 90 percent of the safe recommended intake of methionine-cystine, even though beverages were not included.

SUMMARY

The methionine and cystine contents of 71 different dishes frequently served at lunch in the Cafeteria of the School of Medicine of the University of Puerto Rico was determined. It was found that these lunches, if fully consumed, could supply anywhere between 36 and 90 percent of the daily recommended allowance of methionine-cystine.

RESUMEN

Se determinó el contenido de metionina y cistina en los 71 platos servidos con mayor frecuencia a la hora del almuerzo en la Cafetería de la Escuela de Medicina de la Universidad de Puerto Rico. Se encontró que un al-

muerzo completo compuesto por estos manjares, si se consume todo, puede suministrar entre el 36 y el 90 porciento del requerimiento diario de metionina-cistina.

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