Amino Acids

The NUTTAB 2010 database itself does not contain information on the amino acid content of foods, with the exception of Tryptophan. What amino acid information is available is provided in a separate file, the NUTTAB 2010 – Amino Acid File. The list of foods in this file is conveniently small at 98 items. The quantities are given per gram of nitrogen (/g N), which reveals protein quality irrespective of any absolute quantity. I decided that essential amino acid content was an ideal starting point for learning the nutritional value of foods. Although nutrition information on the web in general appears to accept the older amino acid requirements recommended in 1973 by FAO/WHO (e.g. Lysine = 12 mg/kg/d), I adopted the more recent and more demanding standards given in 2002 by the Institute of Medicine (e.g. Lysine = 38 mg/kg/d). I calculated my requirements for the eight essential amino acids, taking 60kg as a sufficiently accurate estimate of my body weight. The figures were determined thus (mg):

isoleucine	1140
leucine	2520
lysine	2280
methionine + cysteine	1140
phenylalanine + tyrosine	1980
threonine	1200
tryptophan	300
valine	1440

I decided that before proper calculation, convenient preliminary observation of Amino Acid distribution in foods could be obtained by comparing them to those of red meat (beef, lamb and pork). I predicted that my own requirements, as given above, would correlate with the distributions in red meat (as it comes from mammals). Upon very casual inspection, this pattern appeared to hold with two exceptions. First, red meat contains less leucine than lysine, whereas my requirement for leucine is greater. And second, methionine + cysteine in red meat is lower than isoleucine, although my requirements for each are the same.

Since baked beans in tomato sauce is included in the list, I decided it would be excellent starting point for determining the protein quality of an animal product substitute. Upon casual inspection, the essential amino acid distribution of baked beans in tomato is comparable to meat, even superior for some amino acids but noticeably lighter in lysine (as are all non-animal products on the list) and badly lacking in methionine. With the database reporting 0.78 g nitrogen per 100 g baked beans in tomato, I calculated the total essential amino acid content of a standard 425 g can (nitrogen = 3.315 g):

(figures are in mg rounded to 0 decimal places.)

isoleucine	1104
leucine	1770
lysine	1323
methionine + cysteine	215 + 219 = 434
phenylalanine + tyrosine	1276 + 673 = 1949
threonine	1120
tryptophan	295

valine 1240

Therefore two standard 425 g cans of baked beans is sufficient for seven out of eight essential amino acid daily requirements, most importantly lysine. The remainder is methionine + cysteine, which, at 868 mg, falls 272 mg short of the target (1140).

To meet this remaining requirement, I decided on brown rice. The quantity of methionine + cysteine in raw brown rice is 122 + 130 = 252 mg / g N. At 1.22 gN/100g this works out at 307.44 per 100g raw grain, a higher total than for white rice. Thus, it was determined that 2 425g cans of baked beans in tomato + 100 g of raw brown rice is sufficient to meet my daily needs for the essential amino acids.

Elements after the amino acid phase

When prepared in a rice cooker the weight of brown rice expands by slightly over 200%. Thus the total intake of the quantities above is 200g boiled brown rice (Food ID: 02A10329; quantity simplified) and 850g baked beans (ID: 13B20200). The total quantities of important elements are given in the table below:

	Per 850g baked beans	Per 200g boiled brown rice	Total	Institute of Medicine recommended intake per day	Deficit
Calcium	340mg	10mg	350mg	1g	650mg
Chromium	55.25µg	-		35µg	
Copper	1496µg	200µg	1696µg	900µg	
Iodine	19.55µg	-		150µg	130.05µg
Iron	8.075mg	1mg	9.075mg	8mg	
Magnesium	212.5mg	98mg	310.5mg	400mg	89.5mg
Manganese	2.737mg	3.4mg	6.137mg	2.3mg	
Molybdenum	183.6µg	-		45µg	
Phosphorus	731mg	260mg	991mg	700mg	
Selenium	30.6µg	0		55µg	24.4µg
Zinc	4.505mg	1.8mg	6.305mg	11mg	4.695mg
Potassium	2.023g	0.150g	2.173g	4.7g	2.527g
Sodium	3.196g	0.003g	3.199g	1.5g	

Completing the micronutrients

Several further foods were selected to bring all remaining essential nutrients up to adequate levels. The total list of food items and their contributions to all essential nutrients is given below:

	Per 425g baked beans	Per 100g raw (amino acids) or 200g boiled (other nutrients) brown rice	Per 100g wholemeal bread	Per 100g almond	Per 100g peanut	Per 100g carrot	Per 100g broccoli	Institute of Medicine recommended intake per day
isoleucine	1104mg	278.16	381.92	885.95				1140mg
leucine	1770mg	544.12	676.06	1508				2520mg
lysine	1323mg	287.92	247.94	674.83				2280mg
methionine + cysteine	215 + 219 = 434mg	307.44mg	144.76 + 221.76 = 366.52	211.12 + 324.22 = 535.34				1140mg
phenylalanine + tyrosine	1276 + 673 = 1949mg	346.48 + 346.48 = 692.96	471.24 + 297.22 = 768.46	1157.39 + 648.44 = 1805.83				1980mg
threonine	1120mg	267.18	398.86	821.86				1200mg
tryptophan	295mg	95.16	113.96	226.2				300mg
valine	1240mg	425.78	458.92	1036.75				1440mg
Calcium	170mg	10mg	92mg	250mg	54mg	30mg	33mg	1g
Chromium	27.625µg	-	18.6µg	0.4µg	µg	µg	µg	35µg
Copper	748µg	200µg	244µg	1097µg	810µg	49µg	52µg	900µg
Iodine	9.775µg	-	48µg	0µg	µg	0µg	0µg	150µg
Iron	4.0375mg	1mg	2.1mg	3.9mg	2.3mg	0.28mg	0.86mg	8mg
Magnesium	106.25mg	98mg	61mg	260mg	160mg	12mg	22mg	400mg
Manganese	1.3685mg	3.4mg	2.15mg	2.5mg	1.7mg	0.299mg	0.221mg	2.3mg
Molybdenum	91.8µg	-	22.8µg	24.7µg	µg	µg	µg	45µg
Phosphorus	365.5mg	260mg	173mg	480mg	370mg	36mg	81mg	700mg
Selenium	15.3µg	0	11.8µg	3.2µg	12µg	0µg	0µg	55µg

Zinc	2.2525mg	1.8mg	1.19mg	3.69mg	3mg	0.2mg	0.6mg	11mg
Potassium	1011.5mg	150mg	207mg	740mg	540mg	279mg	345mg	4.7g
Sodium	1598mg	3mg	468mg	5mg	1mg	40mg	22mg	1.5g

Reduction of baked beans and necessary substitution.

I then wanted to cut down from two cans of baked beans per day, which seemed excessive, to just one. I also re-evaluated the necessity of the bread intake, which had to remain at 300g per day to keep the iodine sufficient. As a consequence of changing the baked beans per day from two 425g cans to one, two deficiencies resulted: potassium and selenium. The selenium was solved by 100g mushrooms, while this and 50g of dried apricots solved the potassium. Also, milk used in daily caffeinated beverages had to be taken into account to achieve adequate calcium, but was otherwise ignored. The total daily intake at this stage then, was 425g baked beans, 200g rice by wet weight, 300g wholemeal bread, 100g almonds with skin, 100g peanuts raw with skin,100g carrot, 100g broccoli, 100g mushroom, and 50g dried apricots. The total energy intake from these items is 1508.75+1278+2946+2503+2376+132+124+103+443=11413.75kJ. The total fat content is 1.275+2+8.7+54.7+47.1+0.1+0.3+0.3+0.1=114.575g. Therefore, the total energy obtained from fat is 4239.275kJ or about 37% of total energy. The total saturated fat content is 0.4+1.5+3.7+7.1=12.7g. Therefore, the total energy obtained from saturated fat is 469.9kJ or about 4% of total energy. The items contain no cholesterol. The total linoleic acid content is 0.34+0.66+3.06+12.76+14.95=31.77g. Therefore, the total energy obtained from this fatty acid is 1175.49kJ or about 10% of total energy. The total alpha-linolenic acid content is 0.425+0.02+0.45=0.895g. Therefore, the total energy obtained from this fatty acid is 33.115kJ or about 0.3% of total energy. The total protein content is 20.825+5.8+27+19.5+24.7+0.8+4.4+3.3+4.3[note this last number did not factor in the 50g

daily portion of dried apricots]=110.625g. Therefore, the total energy obtained from protein is 1880.625kJ or about 16% of total energy. The total carbohydrate content is 42.925+63.6+119.1+4.8+8.9+5+0.4+1.4+22.2=268.325g. Therefore, the total energy obtained from carbohydrate is 4293.2kJ or about 38% of total energy.

Addition of Canola Oil

After the above calculation the addition was made of 10ml per day of canola oil in order to supplement for alpha-linolenic acid. This obviously changes the exact energy intake distribution summarised above.