Notes on nutrient density of infant foods in Kampala, Uganda

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Summary
Six samples of complementary foods from five different manufacturers were purchased at a central Kampala supermarket in January 2011, and tested anonymously for macro- and micronutrient density at a commercial laboratory in the United States. It turned out that all products had adequate caloric density, but two of the six were short on protein (at only 80% of benchmark values), one of which was also very short on fats, iron and zinc (at 25%, 21% and 38% of benchmark values, respectively). Four of the six samples had very low fat content (under 30% of benchmark values). Nutrient labels on the packaging listed densities for only a fraction of key attributes, and the actual densities were less than half of labeled levels for 6 of the 23 values. Measured nutrient densities are highly variable across products and are often inconsistent with international standards as well as the manufacturers' own labels. This finding is similar to results obtained in 2010 for similarly-packaged infant foods in Accra, Ghana. Products sold on both markets show wide variation and large shortfalls relative to infant needs. Experience elsewhere suggests that achieving higher and more uniform product quality would require introducing a third-party certification service, whose test results would be publically disclosed. Such a service is needed to create a competitive market in which local manufacturers have appropriate incentives to maintain high quality, and local consumers have confidence that each product meets or exceeds the nutrient densities required for child health.

1. Motivation
Previous research in Ghana (Masters, Kuwornu and Sarpong 2011) and Mali (Masters and Sanogo 2002) describe how variation in the nutrient density of composite-flour complementary foods leads consumers to mistrust new products offered by local manufacturers. These products *could* be made to international standards at low cost using local ingredients, and donors often fund the start-up and sale of such products for use in child feeding programs, but individual consumers cannot observe these qualities even after purchasing and feeding these foods to their own children. As a result, producers of these foods intended for local markets have little incentive for consistent use of the expensive ingredients needed for high nutrient densities, and consumers respond by rarely buying these products. The products may occasionally be found for sale in local market, but most consumers trust only the heavily-advertised brand names such as Nestle's Cerelac. Low-income consumers can afford to buy only very small quantities of such expensive products, and are thereby forced to rely on inadequate home-produced foods. To expand the market for low-cost local producers, a third-party certification system would be needed to sample and test their products, offering them a quality-guaranteed label to mark those products whose hidden attributes do in fact meet infants' nutritional needs. Details on this problem, and how third party certification could be introduced to lower costs and increase quantity and quality of complementary foods consumed by low-income children, is posted online at http://sites.tufts.edu/willmasters/research/infant-foods.

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To test the applicability of the Ghana and Mali experience in Uganda, six samples of locally-produced complementary infant foods were obtained at the Uchumi Supermarket in the Garden City Mall on Yusuf Lele Road in Kampala. This market serves the high-income and expatriate community in Kampala, and offers many locally produced items such as specialty coffees and teas in addition to these infant foods, which are rarely available in smaller markets. A similar situation in Accra, Ghana is documented using a formal availability survey in Masters, Kuwornu and Sarpong (20110).

Exhibit 1. The infant-food shelves at Uchumi Supermarket, January 2011

Source: Author's photo.

A set of six products were purchased on January 20th, 2011. Five were in boxes similar to those shown in Exhibit 1, and one was packaged only in a lower-cost plastic sachet. All were in 500 g. sizes. Samples of about 100 g. were removed, randomly numbered and submitted to a commercial food quality testing service in Omaha, Nebraska. The testing we requested was a standard proximate analysis for macronutrients, plus iron and zinc as indicators of desirable micronutrients, and phosphorus as an indicator of phytic acid that limits digestibility.

2. Nutrient density test results

These tests are in no way intended to determine whether a given food could meet all of child's solid-food needs, or even whether the food is safe to eat. We requested no tests for bacteria, aflatoxins or other contaminants; did not test for vitamins or minerals other than iron and zinc; and tested for digestibility only using the rudimentary approach of measuring phosphorus content. What our tests offer is just an X-Ray of the most basic attributes of each food, driven principally by the ratios between major ingredients used in each recipe. A producer wishing to cut costs can readily reduce fat and protein content, which the buyer cannot detect but is revealed by our tests. Actual results of the tests are shown in Table 1.

TABLE 1. NUTRIENT DENSITY OF SAMPLED COMPLEMENTARY FOODS (AS TESTED)

Sam-ple	Calories (kCal/100g)	Macronutrients (g/100 g)				Ash	Minerals (mg/100g)		
		Moisture	Protein	Fat	Carb.	(g/100 g)	Iron	Zinc	Phosphorus
1	383	8.7	15.3	4.9	69.6	1.5	47.3	13.4	1778.0
2	376	8.7	11.4	3.2	75.6	1.2	1.8	1.7	168.8
3	388	9.6	13.2	7.0	68.1	2.1	13.4	4.5	265.1
4	366	9.5	13.4	3.1	71.0	2.9	22.3	1.9	274.0
5	382	7.9	14.8	3.5	72.9	1.0	4.6	2.1	153.6
6	387	6.5	11.4	3.3	77.9	0.8	26.7	13.5	1195.0

As shown in Table 1, samples vary somewhat in moisture content, making it necessary to transform these results into dry matter equivalents for comparison purposes. (These cereals are all mixed with water before serving, so their own moisture content is of no significance for the density of the final product.) Table 2 provides those results, along with reference values for Nestle's Cerelac and the food-aid standards for fortified corn-soy blends, CSB 13 and CSB++. Data for Nestle's Cerelac are obtained from Masters, Kuwornu and Sarpong (2011), while the food aid standards are from Webb et al. (2011).

TABLE 2. NUTRIENT DENSITY OF SAMPLED AND REFERENCE FOODS (% OF DRY MATTER)

	Calories	Macronutrients (g/100 g)			Minerals (mg/100g)		
Sample	(kCal/100g)	Protein	Fat	Carb.	Iron	Zinc	Phosphorus
1	420	16.8	5.3	76.2	51.8	14.7	1947.9
2	412	12.4	3.5	82.8	2.0	1.8	184.9
3	425	14.5	7.7	74.6	14.7	4.9	290.4
4	401	14.7	3.4	77.8	24.4	2.1	300.2
5	418	16.2	3.8	79.8	5.0	2.3	168.3
6	424	12.5	3.6	85.4	29.2	14.8	1309.2
Cerelac	482	15.7	13.8	73.7	9.2	4.7	330.7
CSB13	386	15.9	8.7	na	10.6	5.9	522.0
CSB++	397	15.2	9.6	na	12.5	7.6	334.0

For ease of comparison, these data are shown in Table 3 as a percentage of the benchmark commercial product, Nestle's Cerelac. As Table 3 reveals, two of the six samples were very short on protein (about 20% below Cerelac and CSB++), four were very short on fats (under 30% of Cerelac and far below CSB++), and two were short on both protein and fats. Those two are also short of iron and zinc, and one other sample was short of both fat and zinc. In addition, two of the six samples had high phosphorous levels, suggesting high levels of the anti-nutrient phytate. Overall, one-third of the samples were notably deficient in protein, fats, iron and zinc. Others are low in fats only, or in specific nutrients.

TABLE 3. NUTRIENT DENSITY OF SAMPLED AND REFERENCE FOODS (% OF CERELAC)

	Calories	Macronutrients (g/100 g)			Minerals (mg/100g)		
Sample	(kCal/100g)	Protein	Fat	Carb.	Iron	Zinc	Phosphorus
1	87%	107%	39%	103%	561%	311%	589%
2	85%	79%	25%	112%	21%	38%	56%
3	88%	92%	56%	101%	159%	104%	88%
4	83%	94%	25%	106%	264%	45%	91%
5	87%	103%	28%	108%	54%	48%	51%
6	88%	80%	26%	116%	316%	313%	396%
Cerelac	100%	100%	100%	100%	100%	100%	100%
CSB13	80%	101%	63%	na	115%	126%	158%
CSB++	82%	97%	70%	na	136%	160%	101%

As shown in Table 3, calorie densities for all six of the samples are at least 10% below that of Cerelac, but are above the calorie densities of the two reference food-aid formulations. The food aid formulations differ from Cerelac mainly in having less fat and more minerals than Cerelac. The sampled foods are more similar to CSB than they are to Cerelac, but all samples have even less fat than the CSB standard, and several fall short of the CSB standards for protein and minerals as well.

3. Accuracy of nutrient labels

Product packages list nutrient content claims for all but one of the samples. Each nutrient label refers to a somewhat different mix of nutrients, as shown in Table 4. Nutrients that are not listed on the labels are shown as “na” in the table, while actual results are shown as a percent of the labeled claim. For one of the four products, actual protein levels were far short of the labeled claim, containing 67% of the labeled claim, and actual levels of iron and zinc were also low, at 63% and 46% respectively of the labeled claim. Another product had labeled claims for micronutrients only, and in that case actual values were even lower at only 4% and 18% of the iron and zinc claims, respectively. A third sample had a very high level of iron, at 350% of the labeled claim, but a very low level of zinc, at only 5% of the labeled claim.

TABLE 4. NUTRIENT DENSITY OF SAMPLED FOODS (% OF LABELED VALUES)

	Calories	Macronutrients (g/100 g)			Minerals (mg/100g)		
	(kCal/100g)	Protein	Fat	Carb.	Iron	Zinc	Phosphorus
1	105%	120%	89%	na	350%	5%	na
2	na	na	Na	na	4%	18%	33%
3	106%	104%	128%	na	169%	41%	na
4	na	na	Na	na	na	na	na
5	100%	67%	95%	na	63%	46%	153%
6	97%	116%	Na	97%	na	na	na

4. Pricing and ingredients

Table 5 shows pricing and labeled ingredients for the sampled products. Three of the six list fish (enkejje), and two list "minerals" (suggesting *added* minerals). Pricing varies widely, with two products priced high (2500 and 2600 Ugandan shillings, or about US$1.00 per 500 g. box), two priced at an intermediate level (1700 USh), and two priced low (1400 USh, or about US$0.55). There is no clear link between price and the actual nutrient density of the product: one of the two high-priced products (sample #2) had the lowest density of all the products in terms of protein, iron and zinc.

TABLE 5. PRICES AND LABELED INGREDIENTS

Sample	Price (per 500 g.)	Labeled ingredients (in labeled sequence)
1	1700	Soya, Maize, Carrots, Enkejje, Vitamins and Minerals
2	2500	Rice flour, Oats, Soya bean, Fish, Vitamins
3	2600	Maize, Sorghum, Soya, Millet, Vitamins and Minerals
4	1400	Skimmed Milk, Soya, Nkejje (Haplochromis and millet)
5	1400	None listed
6	1700	Selected Soya, Milk, Maize and Sucrose

Labeled ingredients bear some relation to measured nutrient density, but in a way that suggests very limited control over ingredient ratios: two of the six products list minerals as an ingredient, and one of them turned out to have extremely high mineral content at over 500 and 300 percent of the iron and zinc content of Cerelac, which is also many times the standard used in food aid.

5. Conclusions

The complementary infant foods currently marketed in Uganda have highly variable nutrient densities, which are not consistent with international standards or their own product labels, and are not accurately signaled to consumers by the level of price or ingredient labels. Of the six products sampled, none meet the international food-aid standards for fortified corn-soy blends on all the tested nutrients. This result does *not* imply that these products are harmful to children, relative to the alternatives that are actually available at home. Achieving adequate nutrient density is quite labor intensive, and home-made mixtures are often found to have even lower densities than what is found here (for test results from Ghana, see Nti and Lartey 2007). What our test results show is the predicted outcome of a market in which consumers cannot observe product quality, and so producers have no incentive to maintain it. In such markets, prices and labels are not trustworthy guides to product quality. Consumers may not get their money's worth at any price, and so rarely purchase them – despite the fact that producers can, and do, produce some high-quality products. To help consumers identify the high-quality products, so that producer can sell them, a third party system of quality certification would be needed.

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