No. 891.11 [D28]

DEVELOPING FOOD-BASED RECOMMENDATIONS TO COMPLEMENT DISTRIBUTION OF A POULTRY-BASED FORTIFIED FOOD FOR SCHOOL-AGED CHILDREN FROM RURAL QUETZALTENANGO, GUATEMALA USING THE OPTIFOOD LINEAR PROGRAMMING TOOL

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ABSTRACT

Background: Current diets of school-aged children in Guatemala are nutritionally inadequate. Spammy®, a poultry-based fortified food was developed to complement the local diet.

Objective: To develop food-based recommendations (FBRs) using linear programming for children from a low socio-economic, rural area in the department of Quetzaltenango according to habitual dietary practices and the local food supply, and to examine the effect of this modeling with the addition of Spammy® given as food aid.

Methods: 24-h dietary recall data for 100 school-aged children were used to derive linear programing inputs, including foods consumed, their portion sizes and frequency of intake. Optifood was used to develop FBRs based on existing dietary patterns using locally available and acceptable foods, and with the addition of Spammy®. The cost of the most affordable and nutritionally best diet was also modeled.

Results: A total of 5 food-based recommendations (promoting dairy, fortified grains, eggs, meat/poultry and fruit consumption) can help achieve nutrient adequacy for 7 of 12 nutrients examined. With the additional of a daily portion of Spammy®, 4 food-based recommendations (promoting dairy, fortified grains, eggs, and tortillas) can help achieve nutrient adequacy for 10 of 12 nutrients examined and the daily cost of the most affordable and nutritionally best diet is reduced from $2.23 to 1.75 (USD).

Conclusion: Context-specific FBRs could ensure adequate levels of most nutrients examined. Used alone, however, the proposed FBRs are unlikely to contribute sufficiently to calcium, vitamins C and D, iron and zinc intakes. With the addition of Spammy®, more nutrient requirements are met, but calcium and iron intakes remain problematic.

BACKGROUND

In Guatemala, micronutrient deficiencies constitute a significant nutritional problem, reflected in the development of children. Current diets of school-aged children are overfed with calories, but underfed with micronutrients.[1-2]

Spammy®, a poultry-based, fortified food was developed to complement the local diet of children. It contains micronutrients found to be low in this age-group.

OBJECTIVE

To develop food-based recommendations (FBRs) using linear programming for children from a low socio-economic, rural area in the department of Quetzaltenango, Guatemala, according to habitual dietary practices and the local food supply, and to test the effect of this modeling with the addition of Spammy® given as food aid.

METHODS

Setting: Public school in the rural setting of Quetzaltenango, Quetzaltenango, Guatemala.

Subjects: A total of 115 school children with ages ranging from 8 to 11 years old were recruited.

Data collection: Each child completed a single, pictorial 24-hour prospective diary and a face-to-face interview to check for completeness of the diary and to estimate portion sizes.

Data Handling: Data were used to derive linear programing inputs, including foods consumed, portion sizes and frequency of intake per day/ week.

Data analysis: Optifood software was used to develop FBRs based on existing dietary patterns using locally available and acceptable foods. This process was then repeated with the addition of Spammy® (portion of 43 g). The cost of the most affordable and nutritionally best diet was also modeled.

Analyzed nutrients include protein, iron, calcium, zinc, thiamine, niacin, riboflavin, folate, vitamins A, B_6, B_{12}, C and D. The latter is not included in Optifood software, but was manually added. Dietary reference data were taken from the assorted FAO/WHO reports.[3-5] Food composition values were primarily derived from the USDA National Nutrient Database for Standard Reference, version 26.[6]

Problem nutrients were defined as those unlikely to be met by children who consume diets based on habitual dietary practices and the local food supply.

RESULTS

Table 1: Daily contribution to daily requirements in two diets modeled by Optifood and 'problem nutrients' identified, based on observed diets of Guatemalan schoolchildren and with the addition of Spammy®[1]

Based on the observed diets of Guatemalan schoolchildren			Based on the observed diets and the addition of Spammy®		
Nutrient	%RNI[2] Diet A[3]	%RNI[2] Diet B[4]	Nutrient	%RNI[2] Diet A[3]	%RNI[2] Diet B[4]
Iron[5]	73	72	Iron[5]	77	77
Vitamin D	82	88	Vitamin D	216	260
Calcium	63	90	Calcium	67	91
Protein	213	269	Protein	213	216
Vitamin A	238	250	Vitamin A	259	236
Vitamin C	89	100	Vitamin C	200	205
Thiamin	169	152	Thiamin	217	230
Niacin	145	157	Niacin	191	172
Riboflavin	185	221	Riboflavin	313	352
Vitamin B_6	153	158	Vitamin B_6	278	272
Folate	160	160	Folate	163	176
Vitamin B_{12}	164	230	Vitamin B_{12}	333	366
Zinc[5]	90	100	Zinc[5]	126	128

[1] Problem nutrients: <100% of RNI met in both diets modeled in Optifood.
[2] Recommended Nutrient Intakes (RNI);[3-5]
[3] **Best Diet A'** represents the nutritionally best diet possible whilst adhering to the average food patterns of the population.
[4] **Best Diet B'** represents the nutritionally best diet that could be consumed by the population given local available foods and serving sizes. However, this is a diet that deviates from the observed average food patterns of the population in order to improve nutrient content in relation to the target nutrient RNIs.
[5]The assumed bioavailability of the diet was 5% for iron and low for zinc.

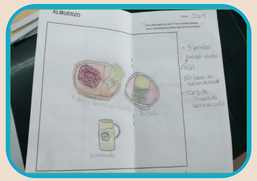

Table 2: Cost of the nutritionally-best modeled diet[1]

	Cost/week
Based on the observed diets of Guatemalan schoolchildren	17.0 Quetzales
Including Spammy® in the diet (at no cost)	13.4 Quetzales

[1] This diet does not cover the requirements for all nutrients, but provides the highest possible contribution to the RNI for this population.

Table 3: Proposed Food-Based Recommendations (FBRs) for 8-11 yr old schoolchildren from rural Quetzaltenango, Guatemala

Food	Frequency per week	Servings per day	Estimated serving size (g)[1]	Total quantity per day (g)
Schoolchildren (who do not receive Spammy®) should consume at a minimum:				
Cheese or milk	7	2	35/180[2]	70/360
Fortified grains such as *Incaparina*® or oatmeal	7	2	30[3]	60
Eggs	7	1	45	45
Meat or poultry	7	1	85	85
Fruits	7	2	100	200
Schoolchildren who receive a daily portion of Spammy® should consume at a minimum:				
Cheese or milk	7	2	35/180[2]	70/360
Fortified grains such as *Incaparina*® or oatmeal	7	2	30[3]	60
In addition, the following are recommended:				
Eggs	7	1	45	45
Tortillas	7	3	30	90

[1] The estimated serving sizes are based on the dietary data collected by means of a single, 24-h self-drafted, pictorial registry in 115 school children;
[2] The recommended serving size is 35 g for cheese and 180 ml for milk; [3] Although the observed median portion size was 15 g, a portion size of 30 g is recommended (i.e. a thicker gruel).

DISCUSSION/CONCLUSION

In the study population, even optimally modeled diets (respecting usual food patterns) were not able to cover the requirements for calcium, vitamins C and D, iron and zinc. However, the adequacy of various problem nutrients was improved when FBRs were incorporated. Diets that incorporated FBRs based on existing population dietary patterns were able to reach >65% of the RNI for 7 of 12 nutrients.

The addition of a daily portion of Spammy® to the diet improved the quality of the diet considerably. Spammy® was an important contributor of 10 of 12 micronutrients examined and reduced the cost (as complementary food aid) of the most affordable and nutritionally best diet.

It is possible that if the recommendations deviated from current dietary patterns, it would not be possible to achieve nutrient adequacy for these children using locally-available foods only.

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ACKNOWLEDGEMENTS

The research was funded by Hormel Foods Corporation, USA.

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