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# Center for Studies of Sensory Impairment, Aging, and Metabolism (CeSSIAM)

BULLETIN OF RESEARCH ABSTRACTS




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# Editorial

## The National Science and Technology Medal 2010

*But I'm stuck like a dope with a thing called hope,*
*And I can't get it out of my heart!. . Not this heart*
From "A Cockeyed Optimist," sung
by Nurse Nelly in *South Pacific*

The Silver Jubilee of the Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM) was an event that most would have thought – 25 years ago -- was unlikely ever to come to pass. In this the second semester of 2010, we completed A quarter of a century of surviving – and most often thriving – in one of the most intriguing and beautiful countries of the world. As the saying goes, no one can ever be a Prophet in his own Land. Well, as I write this Editorial, I feel the need to present evidence that, in my particular case, I may have beaten the odds on the prophecy issue, by becoming a Prophet in my (adopted) Land.

Exhibit A for this thesis was lifted out of a leather case and placed around my neck in Salon del Pueblo in the Congress of the Republic of Guatemala on Monday, December 13th at about 11 a.m. on a sunny, blue-sky morning. It was th e 2010 National Science and Technology Medal of the Guatemalan Council of Science and Technology (CONCYT) in the hands of the Vice President of the Republic, Dr. Raphael Espada. Also on hand, and co-hosting the presentation ceremony was Congressman Roberto Alejos, the Speaker of the unicameral Guatemalan Congress. The CONCYT is part of the System of Science and Technology (SINCYT), which was created in 1994 to promote the development of science, technology and innovation among the public, private and academic institutions of the nations. So when I was invited by Maria del Carmen Samayoa of the National Academy of Medical, Natural and Physical Sciences and Dr. Erwin Calgua of the *OXLALJUJ N'OJ* Foundation to have my name entered in nomination for the 2010 Medal, I was clearly oriented and motivated by those who had gone before. A challenge was the fact that, although is permitted by the rules for a non-Guatemalan to compete for the award with greater than five years of residence (I had been in Guatemala seven-times that number of years), none had ever received the award across the first 13 medalists.

The Medal was created in 1997 to honor outstanding achievement in science and is officially conferred annually by an act of the Congress of the Republic. The inaugural awardee in 1997 was the noted food scientist, Dr Ricardo Bressani, the creator of the mixture high-protein vegetable, Incaparina®. There is, indeed, no figure in the history of investigation with greater accomplishments than Bressani. The seventh winner was the late Dr. Benjamin Torun, a companion of mine during my first decade in Guatemala in the Biomedical Division of the Institute of Nutrition of Central America and Panama. There is a common thread I share with these two distinguished professional that weaves between Guatemala City (my adopted home) and Cambridge, Massachusetts (my place of birth); that is the role of mentoring in our professional formation by Prof. Nevin Scrimshaw. Dr. Bressani was among the first generation of young staff members selected in the early formation of INCAP, and the most productive in terms of publications in international journals. Dr. Torun left Guatemala to join Prof. Scrimshaw at the Department of Nutrition and Food Science of the Massachusetts Institute of Technology for his PhD training, and returned to INCAP as second in command of its medical Division. I first worked with Nevin Scrimshaw through an elective exchange with MIT as an undergraduate at Harvard. I was then recruited in 1977 to his Department at the MIT as an Assistant Professor, within two years of arriving in Guatemala as an affiliated investigator in INCAP. Finally, with the advent of CeSSIAM, in 1985, it was the International Nutrition Foundation in Boston, presided over by Dr. Scrimshaw that received and channeled international funding to its project destinations in Guatemala, a role that the Foundation continues to the day. The research philosophy of this giant of the nutritional science was his gift to Bressani, Torun and Solomons, which showed us that breadth of vision and flexibility and ingenuity in pursuit of investigative goals, were virtues for work in a developing society like Guatemala. Do not be afraid to ask interesting questions about the nature of human nutrition, and once you have the query in focus, find a way to sort it out. If not the personal grooming of Dr. Scrimshaw, at least his philosophical tenets are a solid key to making one's way through the investigative labyrinth of the Land of Eternal Springtime.

It has not always been springtime in the research environments of Guatemala. INCAP perhaps was in its Golden Age when I first entered its gates to report to the Biomedical Division on January 22, 1975, with a diversity of divisions all with there committed leadership and exciting research projects. Less than 13 months later, however, on February 4, 1976, the 7.6 Richter scale earthquake, which opened up great cracks in the soil of the nation, affected the tranquility and rhythm of INCAP's project. It set in motion a demographic change in Guatemala, accelerating the rural-to-urban migration in the country. I was part of a metabolic ward situation in the Division, which consolidated my clinical experience in nutrition. I able to conduct extensive research on the lactose maldigestion in children and adults, and to examine the absorption of zinc and the factors that influenced it. The fog rolled in again over the INCAP on June 20, 1980, when the Director and Administrator of the Institute were kidnapped from the staff meeting hall and held for ransom for over two months. What followed was the forced exile of my mentor and Division-chief, Fernando Viteri, and the withering away of the creative and innovative spirit in investigation. When the climate moved to the point of censorship of new ideas, it was time to seek a refuge. Biochemist, Dr. Oscar Pineda, felt the confinement and stultification within the INCAP walls, and connected us with Doña Elisa Molina de Stahl, president of the National Committee for the Blind and Deaf. Through the good offices of Drs Fernando Beltranena and Gustavo Hernandez-Polanco at the "Rodolfo Robles" Eye and Ear Hospital, we were given a haven for exploring a new way forward for biomedical research. This was to signal a major climatic shift for me and my scientific efforts, but not a season without stormy weather.

The title words of this editorial from the show tune, *Cockeyed Optimist,* summarize my spirit in the creation of the platform for my last quarter of a century. On July 1, 1985, the Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM) was launched. One might be a prophet and leader, but nothing can be accomplished without the collaboration of others I have been supported by collaborators of every nature, beginning in the early years at INCAP and accelerating through the opening decade of CeSSIAM. Dr. Pineda, a recently graduated physician, three final-year medical students, and the clerical assistance of Mrs. Julisa Gallego, were present at the launching. Shortly thereafter four young physicians took up their positions as heads of the four divisional areas of the Center. We chose to cover a range of emphases, from the hearing and visual impairment that interested the Committee, to the conventional maternal and child health focus, and on to a specific focus on vitamin A, and out on a limb to issues of aging and the elderly in a Central American setting. Moreover, when it came to nutrition we studied not only nutrients, but dietary patterns, and on the nutrient front, we have been interest not only in deficiencies but excesses such as obesity and iron overload.

In the first decade of CeSSIAM, developers and researchers around the world connected us with novel research techniques of the era. Bioelectrical impedance spectroscopy and plethysmography and stable isotope markers like doubly-labeled water and isotopically-enriched retinol were two of these. On a practical vein, we worked out a manner to combine oral edible enzymes with meals of cooked beans to reduce the gaseousness and flatulence from the experience and we determined the threshold for riboflavin in the diet that would prevent deficiency in the elderly. One of the most exciting and liberating aspects of the early 1990s, was to break out and challenge conventional thinking with editorial commentaries in the scientific literature. Our work with vitamin A deficiency in CeSSIAM pointed us to the question of why is there a need for fortifying sugar if the population apparently consumed diverse sources of provitamin A carotenes. In reviewing our own research with bioconversion of carotene in carrots, Jesús Bulux came to realize a consistency of underavailability of vitamin A from plant sources. We called upon the nutrition community to revisit the assumptions about efficiency of plants' yielding vitamin A. It made us more than a few enemies in vitamin A circles, but we were vindicated by experimental work from many research groups. Interestingly, in our contemporary studies, we are collaborating with the University of Newcastle in the post-genomic age on gene frequencies of the genetic allele that governs the efficiency of intestinal oxidation of beta-carotene to vitamin A. In the same era, with Manolo Mazariegos and two co-authors from the University of California at Davis, we challenged the concept that poor linear growth (stunting) was primarily related to dietary deficiencies. We proposed the alternative hypothesis that environmental contamination is the major force, just as poultry and livestock grow poorly unhygienic conditions. Currently, with collaborators from McGill University, we are extending this work on immune and oxidative stress as factors for linear growth delay.

Coincidently, this prestigious award came to me and to CeSSIAM at the culmination of the 25th anniversary year of the Center. It has been the positive contributions of my colleagues over 25 years at CeSSIAM and the corresponding earlier efforts of my mentors and colleagues at the Institute of Nutrition of Central America and Panama (INCAP) that enabled me to fathom the issues, overcome the barriers, and forge through to the research findings along my career. CeSSIAM originated as a statement for freedom and initiative in research. That could not have been done if there had not been flexible money for pursuing novel hypothesis. In this regard, aspecial mention is warranted for two individuals who have given from their personal resources: Mr. Alan Kligerman, CEO of the AkPharma Inc (see Editorial, p 11) and Prof. Klaus Schűmann, President of the Hildegard Grunow Foundation.

As a (now) past awardee of the National Medal of Science and Technology, I assume automatic membership on the *Consejo de los Notables* (Council of the Distinguished Ones), with a role to provide guidance for further scientific and technological development and progress of the nation. I would hope, in fact, that that is what I have been doing by personal example and through scientific production for the past three and one-half decades. In closing, I cannot emphasize too much nor too often what an honor it is for an expatriate to receive a national awarded in an adopted land. The establishment of the Medal mentions science in "benefit for the nation." The letter from Dr. Rosa Maria Amaya de Lopez, announcing the awarding of the Medal mentioned the criteria of the "social relevance" of the science. The Vice President, in his discourse, mentioned the "economic sacrifice" of the investigator. During the height of the years of civil conflict in Guatemala, I would tell my skeptical friends that I would rather die in Guatemala, than live in another country and cultural. Life is about choices, and my electing to work within the Guatemalan context, to train students and professionals from all nations of world and disseminate scientific findings to all corners of the globe has certainly been the right one for me. This was the vindication I felt with the little tug around my neck from a 6 cm metal encraved disk suspended from a blue and white ribbon standing in the Salon del Pueblo (Hall of the People) on the lucky day of December 13, 2010.

**Dr. Noel Solomons, MD**
**Scientific Director**
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# Studies on the Ecology of Giardial Infections in Day-care Center Children of Quetzaltenango

TL Duffy, G Montenegro-Bethancourt, C Arriaga, MJ Rios, NW Solomons, M Belosevic, and MT Clandinin

It has been recognized since the mid 1980s, that infection with the protozoan parasite, *Giardia intestinalis*, is common in day care centers. The close proximity of children makes person-to-person tradition by the fecal-oral route of transmission a common event. The policy question of merit is how much risk the parasite represents to the health of an individual versus the adverse aspects of the drug treatment, with agents such as metronidazole, in side -effects, expense and risk of fomenting drug resistance.

Until recently, the only diagnostic test for giardial infection was by light microscopy on a fecal sample. About a decade ago, a diagnostic test based on detecting specific antigens of the protozoa (coproantigens) by the enzyme-linked immunosorbent (ELISA) test. Within the past few years, a portable, simple, color-indicator strip ("dipstick") test to detect *Giardia* in fecal samples has been commercialized. In 2009, we found a range of prevalence of *Giardia* infection from 10 to 50%, in urban and semi-urban day-care centers of the municipality of Quetzaltenango in the Western Highlands of Guatemala using the ELISA method (ProspectT-Giardia-EZ-microplate, Remel, USA).

The aforementioned dilemma of damage from infection and damage from pharmaceutical treatment has raised interest in alternative approaches to eradicate or suppress giardial infection in the human intestine. It has been postulated that various edible substances in the diet may serve to counteract infestation with *G. intestinalis*. Among the candidates has been wheat germ lectins, which were shown to reduce the viability of cultured *Giardia* in vitro. [1] Oral feeding of wheat germ showed demonstrable efficacy in reducing human infections [2] Gangliosides, a type of lipid found in breastmilk, has shown promise in in vitro experiments to cause the lysis of *Giardia* [3]. As preparation for an intervention trial with ganglioside supplementation, a team from CeSSIAM and the University of Alberta undertook a series of studies in 2011 in semi-urban daycare centers to better understand the ecology of giardiasis in these institutions.

The study had three interrelated objectives. The first was to determine the prevalence of intestinal colonization with *G. intestinalis* in semi-urban daycare centers and the stability of infections. The second was to compare the diagnostic correspondence in the same fecal sample with microscopy, dipstick (RidaQuick, Germany) and ELISA (Remel) techniques. Finally, we inquired from the data whether or not intestinal colonization with *Giardia* is associated with a poorer status of physical growth of the children.

**Prevalence of Giardial Infection**

A total of 53 children were consented for the study, but one or more stool samples were collected in only 48. The goal of the collection plan was to obtain two fecal samples in all participants in week zero and two more samples in week four, with an interval of about 30 days in the middle, which would have yielded 192 specimens. Due to lapses in full collaboration, the total number of samples collected and processed by the ELISA method (Remel) was 151, with only 23 children providing all four requisite samples for analysis.

At baseline, the number of stools with a positive coproantigen response in at least one stool among 48 contributors was 21 (44%), and this was 17 (45 %) for the 38 donating a sample in week 4. Of 15 children initially antigen-positive and who provided 1 stool at both ends of the study, 4 converted to antigen-negative, for a spontaneous clearance rate of 26% for infected, and 10% for the sample as a whole. Of 23 children initially antigen-negative in the same class of compliance, 6 became antigen-positive by week 4, for a new infection rate of 26% for susceptibles, and 16 % for the sample as a whole.

**Comparative Diagnosis of Infection**

The study design called for subjecting the first sample submitted by a child in each phase of collections to examination by microscopy, dipstick and ELISA for inter-method comparison. The velocity with which the fecal samples were collected oversaturated the capacity of the microscopist (T-L.D.) to process fresh specimens of even a single stool from all children, such that only 75 samples underwent all three analyses. For the two tests performed on frozen, stored specimens, it was possible to compare 99 samples by dipstick and ELISA. Within the distribution of positive and negative responses actually seen in the samples delivered by the young children, the correspondence of giving the same diagnosis (positive – positive or negative – negative) across the two methods is illustrated in **Table 1**. Any two methods registered a three-quarters concordance or higher throughout the series, The correspondence in sensitivity and specificity between and among methods is shown in the **Table 2.**

**Giardia and Growth**

The height and weight of the children were measured and converted into the indicators of weight-for-age, height-for-age, weight-for-height Z scores. Hypotheses were tested by both the binary question (Chi square) and the continuous -variable approach (Spearman correlation). There was no relationship between any anthropometric index and giardial infection. However, within the group of infected children, a suggestive association ($r = -0.32$, $p = 0.08$, one-tailed test) was found between intensity of infection (optical density {OD} values in ELISA)

and weight-for-age Z-scores. Spearman correlations with a much lower order of magnitude, but always with an inverse association, were found for height-for-age and OD values ($r = -0.26$, $p = 0.12$, one-tailed test) and weight-for-height and OD values ($r = -0.08$, $p = 0.36$, one-tailed test)

**Conclusion**

As has been reported in other regions, giardial infections are common in daycare centers of Guatemala. The spontaneous acquisition and clearance rates are about the same, with ~10% of uninfected children becoming infected over 4 weeks and ~10% of infected children turning *Giardia*-free. The microscopy and dipstick detect only about half of the truly *Giardia*-containing stool samples, those with the most intense internal infestations. They are useful for screening a population, but deficient for identifying all of the specific individuals with the infection. The sample-size here does not permit a powerful analysis of the relationship of giardiasis and growth, but the trend for all indicators is toward a negative association.

**Projection:**

The results in the present study represent more than "findings of interest." They actually provide tools for the more precise design of a randomized, controlled field intervention trial to test whether feeding ganglioside extract can eliminate or prevent new infection with *G. intestinalis*, as compared to plain milk. The study provided guidance on how the dipstick can be used to identify sites of promise for inclusion, and to stratify individuals within the sample so as to balance the number of infected and non-infected children within each treatment group. Most importantly, the prevailing rates of background giardiasis and the spontaneous changes provides the exact information needed to determine the sample size with the appropriate statistical power to test the hypotheses related to ganglioside efficacy for giardiasis suppression or prevention.

Table 1: Agreement among various combinations of fecal tests for *Giardia* detection

| Test combination | Sample results in agreement (%) |
|---|---|
| **ELISA & Dipstick (n = 99)** | 79.8 |
| **ELISA & Dipstick (n = 75)** | 84.0 |
| **ELISA & Microscope (n = 75)** | 78.7 |
| **Microscope & Dipstick (n = 75)** | 89.3 |
| **All 3 Methods (n = 75)** | 74.7 |

Table 2: Sensitivity, specificity, PPV and NPV of microscope and dipstick tests for Giardia detection in stool samples using ELISA as gold standard

| | Microscope (n = 75) | Dipstick (n = 75) | Dipstick (n = 99) |
|---|---|---|---|
| **Sensitivity** | 53.6 | 60.7 | 50.0 |
| **Specificity** | 100 | 97.9 | 96.8 |
| **PPV** | 100 | 94.4 | 90.0 |
| **NPV** | 78.3 | 80.7 | 77.2 |

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# Dietary and Gender Correlates of Ambient Fecal Reactive Oxidant Species (ROS)

M Orozco, C Arriaga, NW Solomons, and K Schümann

The gastrointestinal tract is one of the systems most prone to degenerative and neoplastic diseases. It has been proposed that the basis for the development of gastrointestinal diseases such as Crohn´s and ulcerative colitis, is the failure to adequately quench and contain free-radical formation in the intestinal lumen.

Experimental systems have been developed and demonstrated for quantifying in situ susceptibility of the fecal milieu to oral iron supplementation, first in Norwich, UK and subsequently by our group in Guatemala [Orozco et al 2010a, Orozco et al 2010b]. Up until now, the discussion has been regarding the effects of dietary oxidants, such as iron [Lund et al, Lund et al, Orozco et al 2010a, Orozco et al 2010b] and their mitigation [Orozco et al 2010a]. However, the potential for variation in the background intraintestinal oxidation has received no attention. Currently, there isn´t a clear notion of the existence of or magnitude of any intra-individual variance in intrinsic free-radical quenching and buffering capacity, and its stability as a "state" or a "trait" within a given individual.

The objective of this analysis was to determine if a variation in habitual dietary fiber intakes or other associated dietary or life-style exposures contrasting across urban and rural conditions in contemporary Guatemala might influence fecal oxidation mitigation in a significant manner.

This was a secondary analysis,using 40 female subjects from a prospective study in a rural and urban settings (recruited in November, 2010) and from 27 male volunteers who were enrolled in two prior iron supplementation fecal ROS metabolic studies, previously presented [Orozco et al 2010a, Orozco et al 2010b], one in 2005 (n = 17) and the other in 2008 (n = 10). Both studies with men were conducted with an urban sample recruited in Guatemala City.

CeSSIAM´s Human Subjects Committee in Guatemala City provided ethical approval to all study protocols. Subjects signed the informed consent forms assuring that they understood the nature, purposes, inconvenience, risks and benefits of the study. Subjects were compensated for their participation.

Estimated intake of total energy and dietary fiber was calculated only for the female simple by using a retrospective history of all food and beverage intake of the previous calendar day from each of the 40 participants by a team of experienced research nutritionists. Food composition table values for energy values and dietary fiber were obtained from two reference sources [USDA, 2009; INCAP, 2006]. The two consecutive day intakes of energy in kcal and dietary fiber in g were combined into a 2-day mean by subject, and then combined to calculate subgroup averages.

All subjects participating in the study were asked to provide two stool samples during a period of one week. Same number of rural and urban samples was collected in the same weeks. Males provided 3 samples, following the study protocol of interest.

A commercial spectrophotometrically-based assay, the Feren-B-Method kit (Bioanalytic, Umrich, Freiburg, Germany), was used to quantify non-heme iron in the fecal samples. Spectrophotometric readings were made in a spectrophotometer. Non-heme iron was expressed as µg/g of native stool. The buffering capacity of fecal material to quench free-radical generation, an indirect measure of in situ luminal oxidation was assessed with an HPLC-based method adapted from Owen et al (2000), also used in a previous study to evaluate the effects of supplemental iron and antioxidants on the production of ROS in human stools (Orozco, 2009).

**Table 1** shows the comparison of dietary fiber, energy, non-heme and heme iron for both samples of urban and rural females . Dietary fiber consumption in the rural area is twice as high as compared to the urban sample. There are no significant differences in dietary non-heme and heme iron consumption between the two settings.

**Figure 1A** and **1B** illustrates total hydroxylated products and fecal non-heme iron of the urban and rural females, as well as the urban males. Urban men have a significantly higher proportion of intraluminal free radical production, compared to their female counterparts. In terms of residual non-heme iron, rural women and urban men did not differ between each other, while urban women had significantly higher concentrations of this trace element in their stool samples.

Despite the considerably higher consumption of fiber by women from the rural area, apparently there is no protective effect of this nutrient against ambient free radical production in the fecal stream. We can not rule out the potential benefits of fiber supplementation or high fiber intakes in counteracting fecal oxidation in the presence of a exogenous dietary oxidant such as the supplementation levels used in our previous experiences [Orozco, 2010]. One interesting observation from this analysis was that urban men have significantly higher production of ROS than women, but their residual stool non-heme iron concentrations are lower than urban women and do not differ from those of the rural female sample. This phenomena could be explained by fecal transit and fiber consumption. Urban women consumed half of the fiber than rural women, so their stools may be more concentrated, and as a consequence, higher concentrations of non-heme iron. As for the gender differences in ROS production between men and women, there seems to be an undetermined factor that might be protective of women and yet needs to be studied further.

**Acknowledgements:**
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| Area of study | Fiber (g/day) | Energy (kcal/ day) | Dietary heme iron (mg/day) | Dietary Non-heme iron (mg/ |
|---|---|---|---|---|
| Rural | 40 ± 21 | 2528 ± 624 | 2.5 ± 2.5 | 15.8 ± 8.7 |
| Urban | 17 ± 8 | 2360 ± 1121 | 3.3 ± 1.4 | 15.5 ± 7.2 |
| p- values* | 0.0001 | 0.56 | 0.19 | 0.89 |

*Two-tailed t-test

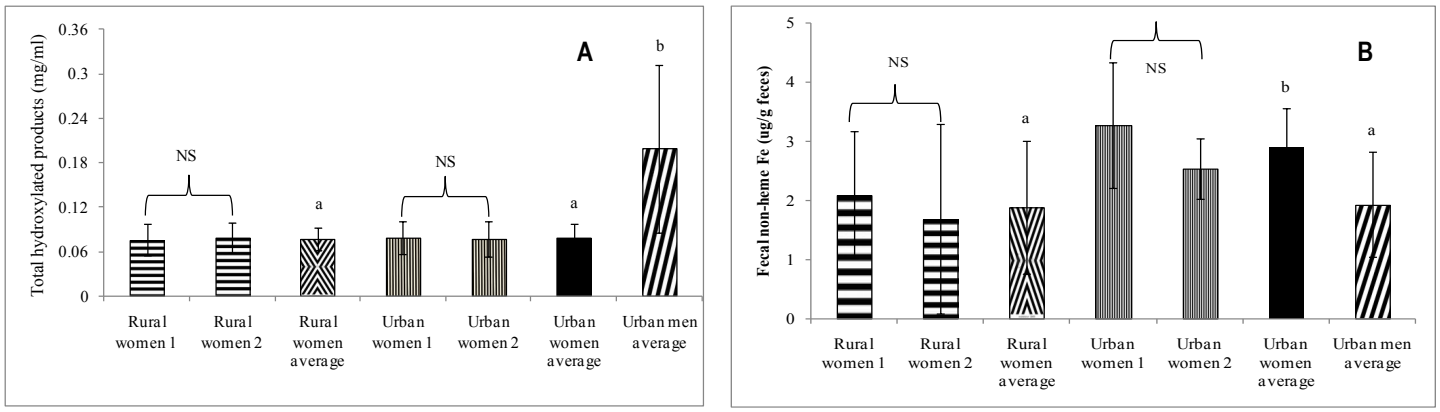


Figure 1:Total hydroxylated products (A) and non-heme fecal iron (B) from stool samples from urban women, rural women and urban men

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# Dietary Fiber Consumption Among Two Convenience Samples of Guatemalan Women

MJ Soto-Méndez, L Hernández, R Campos, M Orozco and NW Solomons

Dietary fiber improves bowel laxation, reduces risk of coronary heart disease, and assists in maintaining normal blood glucose levels. For adult females, the Daily Reference Intake is 25 g/d of total fiber from food sources that include the fiber naturally present in grains, such as those found in oats, wheat, or rice, and functional fiber synthesized or isolated from plants or animals, and shown to be of benefit to health[1].

The objective of this survey is to quantify dietary fiber intake in women from 2 different Guatemalan settings and to determine the main sources. Participants in the study were 20 adult, rural Mayan women from the village of Santo Domingo Xenacoj and 20 adult, urban female students from "Universidad de San Carlos de Guatemala" the state university

Two non-consecutive 1-day recalls of all food and beverages consumed in October-November 2009 were conducted; generating 80 subject-days of data. Using the fiber content of the reported items primary from the USDA[2] database and INCAP[3] database for local foods that do not appear on the first database mentioned, the intake of dietary fiber for each of 80 study days was estimated, and descriptive statistics generated.

Ten leading sources with cumulative percentage of dietary fiber in both areas were tabulated (Table). Mean age of rural women was 31 ± 10 y and urban women, 28 ± 8 y. Energy ranged from 1,399 kcal to 4,294 kcal, with rural women reporting 2,528±624 kcal and urban students reporting 2,149±734 kcal, p=0.035 by Mann-Whitney U test. The fiber intake for all 80 subject-days ranged from 6 to 105 g/d, with 40±21 g and 16±8 g of dietary fiber consumed daily in the respective sites (p<001 by Mann-Whitney U test.

Our findings demonstrate that rural indigenous women have significantly higher dietary fiber intakes than female urban students, which cannot be explained by different energy intakes. Tortillas and black beans where the leading 2 main sources of dietary fiber in both areas of Guatemala. Although dietary fiber intake is higher in the rural area, almost 80% of the fiber was consumed from only 3 different food items, whereas in urban area 50% of the fiber intake was achieved with eight different food items. The quantity of dietary fiber is greater in the rural area but with a monotonous pattern, whereas the diversity of sources is greater in the urban area.

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| Rural Area (n=20) | | | Urban Area (n=20) | |
|---|---|---|---|---|
| Item | Item (%) | Cum (%) | Items | Item (%) |
| Tortilla | 53 | 53 | Boiled black beans | 16 |
| Boiled black beans | 20 | 73 | Tortilla | 13 |
| Mashed black beans | 6 | 79 | Refired black beans | 8 |
| Boiled red beans | 4 | 83 | Mashed black beans | 4 |
| Macuy broth* | 2 | 85 | Psyllium Plantago | 3 |
| Boiled white beans | 2 | 87 | Papaya | 3 |

**Table 1:** The ten leading sources of dietary fiber among rural and urban areas.

# Test-Retest Reliability of a Non-Invasive Hemoglobin Detection Device

C Crowley, C Arriaga, NW Solomons, and K Schümann

The emergence of portable devices for the non-invasive screening of hemoglobin (Hb) has called for a critical evaluation of both their reliability and validity. This study, conducted in an urban Guatemalan setting in the Western Region of the country, focused specifically on determining reliability of such devices. Without reliability and stability across measurements, individual readings obtained from any device cannot be considered a representation of the true value. Although biological error may provide some variation among values, the precision of the instrument, indicated by reproducibility of values within the same individual, is essential for being able to use a single reading as an indicator of the desired value. Therefore, the goal of this study was to determine the stability of measurements over time; both within-day and between days to establish whether or not an individual reading could be used as a reliable indicator of Hb status. Previous findings revealed that an earlier version released by Masimo Corporation (Irvine, CA) demonstrated adequate stability among adult subjects but performed poorly in predictive accuracy. Within-day variability was assessed by taking 1 reading every 2 hours over the course of 6 hours (pooled coefficient of variation 7.2% ±2.9%, n=8). Day-to-day variability was measured by taking 10 once-daily readings over the course of 15 days (pooled coefficient of variation 4.4% ± 2.1%, n=8).[1]

This study sought to evaluate test-retest reliability of the Pronto 7™ (see **Image 1**), Masimo Corporation's third generation device, designed specifically for portability and field use. A group of preschool-aged children and elderly individuals from the city of Quetzaltenango were used as subjects. Each subject was measured 6 times (once daily) over the span of 10 days to determine day-to-day reliability. In addition, all subjects were evaluated hourly, over a 3 hour period (4 measurements total) to establish within-day variability.

Among the 17 children who were sampled, only 6 were able to complete the 6 day-to-day readings. The mean coefficient of variation of these children was 9.2%±2.4% (9.6%±4.1%, minimum of 4 readings, n =17). The mean CV for within-day readings was 5.7%±3.0% (n=9). Among the older adult sample, the mean CV for repeated measures across 10 days was 9.1%± 4.3% (n=15) and for within-day testing was 6.7%± 6.7% (n=25).

The Pronto 7™ exhibited adequate test-retest reliability in both subject groups. Overall, stability was greater for within-day readings, than across readings taken over several days. This demonstrates that the device could be used to determine individual readings. Evaluating the validity of the readings, however, is essential for establishing whether or not the device provides satisfactory predictive accuracy.

**References:**

[1] Crowley C, Montenegro-Bethancourt G, Arriaga C, Solomons NW, Schümann K. Correspondence of a non-invasive, cutaneous-contact method to determine hemoglobin values with conventional whole blood samples within a Guatemalan field setting. Food Nutr Bull 2010 [in press].

Figure 1: Testing the Pronto 7 on a child

Figure 2: Pronto 7™


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## Fluorish-to-Nourish: Financial Support for the CeSSIAM Mission for 25 years

In 1985, in a Guatemala just ending its 36-year civil conflict, Noel Solomons and his co-founder colleagues created an ambitiously - one might say audaciously - named organization, the Center for the Study of Sensory Impairment, Aging and Metabolism (CeSSIAM). It was committed to driving back starvation and malnutrition, with this work being actuated amidst a people so ravaged by such lingering conflict that just keeping body and family together constituted a daily victory for them.

How Noel Solomons knit together, a body of researchers, students, and funders out of the thin air of the Guatemalan highlands deserved reflection. Speaking as a funder, perhaps, we saw in him a representation of some of the things they themselves held dear. The leadership of CeSSIAM is a story far too long for a few editorial paragraphs, a point not lost on those friends of Noel who know he is not a man of -- or describable in -- few paragraphs. The people Noel has engaged to make his fortunate collaborators and those he has directly and indirectly benefitted are legion. They include learned researchers who have collaborated with him and young scientists who have learned and sharpened their craft and gone on to important positions in the larger world, spreading the benefits of the knowledge and ethos acquired during their years at CeSSIAM. Indebted to him and his colleagues are countless now healthier highland and lowland Guatemalan peasants and who knows how many better nourished people elsewhere in the Third World and in third world sectors of the First World? Also in his debt are those who participated as funders for this grand work, and that happily includes your writer as one who has done so from the inception of CeSSIAM to the present. So, so many people have been caught up in Noel's net; nobody associated with him is a passive observer!

I met Noel at David Paige's *Lactose Digestion: Clinical and Nutritional Consequences* symposium at Johns Hopkins in December 1979 and fell under the magic of this dashiki-clad tower of zeal and scientific knowledge. The immediate common interest was that I was in the throes of trying to introduce a more digestible form of cow's milk, in the face of no little institutionalized opposition to the very existence of such a product. Noel and I were both speakers at that meeting and warm mutually beneficial sparks struck between us immediately. Noel was willing to perform non-invasive breath hydrogen assays as inquiries into the validity of this product concept. The assays and the milk drinkers' comfort spoke: the product was valid, it became and remains a U.S. market staple, and my appreciation is huge. The benefit to the lactose intolerant population of a large part of the world was immediate and obvious, and judging from user responses, they are appreciative, also: the product went on to become the largest- selling branded milk in the U.S. today.

Moving beyond commercial market realization efforts, there was no way I could then sever the connection with Noel; I fully realized the importance of his work, from research into vitamin A deficiency's xerophthalmic blindness, work on zinc and other micronutrients and beyond, in continuous expansion of his own *ouvre* via a veritable Niagara Falls outpouring of training and drive focused on scientists-in-the-making. We discussed everything from the shivering blind Guatemalan Lottery vendors to the possibilities of an oral rehydration "bridge" solution, partially composed of dilute lactose-free milk.

I am more satisfied than I can say, to have provided what I could offer of resources available to me to this body of work, which should rightfully be called 'bodies' because of the sheer number of its parts. There has never been the shadow of a doubt in my mind that Noel Solomons and his continuing pursuits embody a high and practical form of person-for-person humanity, and so, for *me*, the structure in fact turns back on itself in a sort of giving/receiving Möbius strip: we are all on the same side, even when on two sides: I know that I am benefitted in the pure pleasure of participation in that which, were I in possession of the training, I would have loved to have done hands-on directly. The collateral benefits of further direct and indirect connections with other financial supporters and individuals who were and still are mentors to Noel, himself, has been icing on the cake.

Here, then, is the not small miracle of synthesis: a gifted driven humanitarian who grafted onto his own vision, talented scientific individuals who could expand and perpetuate his nutritional aims, and then managed to find and persuade persons, foundations and companies who would fund that work. All the legs of the three-legged stool are there. Those of us who have been lucky enough to be any part of that, can only nod with satisfaction and say: "This is good. This is worthwhile. Whatever my trip has been, this has been among the most satisfying parts of it."

Congratulations, Noel Solomons, CeSSIAM and all associated with this endeavor of 25 years.

**Alan E. Kligerman, CEO, AkPharma, Inc**

**Editor's Note: Alan E. Kligerman, the most consistent donor to the research efforts of the institution was to be honored at a special Friends of CeSSIAM Breakfast in Washington, DC in April, 2011.**

## Prizes -- The Surprizes of 2010

This year 2010, has been for me of great pride and satisfaction for being part of three events, unexpected in a certain way, but meaningful for what they represent, and very much congruent with the 25 years of academic activity of CeSSIAM in Guatemala. The first one, is being invited by the Inter-Academy Panel (the Global Network of Science Academies) to attend the World Economic Forum 'Summer Davos' meeting 2010 in Tianjin, China (September); the second is the privilege to be admitted as member of the Academy of Medical, Physical and Natural Sciences of Guatemala; and the third is the honor to be recipient of the 2010 Third World Academy of Sciences Award for Young Scientists (TWAS) offered by the Inter-Academic Panel and the Guatemalan National Council of Sciences and Technology. This is a glory that fills me with pride, not just for my professional development but for my country, Guatemala. For the values that are part of my life, that are shared with those of CeSSIAM, I could not be happier for these events.

Personally, these events represent -- more than a prize -- a commitment. They should be seen as an emblem of the efforts that the different Academies of Sciences make to reduce the gaps in research between underdeveloped and developed countries. However, the opportunity for sharing and exchanging experiences with other young scientists of the world is invaluable. This has allowed me to appreciate that despite the limitations and restrictions in doing research in a Guatemalan context, there are incredible possibilities to adapt science to solve local problems, particularly in health. In that respect, the role of CeSSIAM in my personal education to be able to empower and orients me and make me respond the challenges that young scientist from developing countries confront.. One of the main challenges that we as young scientist have to face is to be part of a scientific community that is evolving very fast. My personal commitment as just integrated of the scientific community, is to evaluate the trends of development, with a complementary vision that helps to reduce the current gaps and that assure the sustainability of science and all the scientific community. This is also a motivational call for the younger, to get involved in the scientific activity and to commit, thinking that we are the ones who should care about the future, because we are the ones who will have to live in it.

Gabriela Montenegro-Bethancourt

## See you at EB 2011 in Washington DC!

**Abstract 996**: Orozco, MN, Arriaga C, Soto MJ, Hernández L, Campos R, Solomons NW, Schümann. Ambient fecal reactive oxygen species (ROS) buffering capacity as a function of geography and habitual diet: A comparison of rural and urban Guatemalan subjects.

**Abstract 1008**: Orozco MN, Romero-Abal ME, Solomons NW, Weiss G, Schümann K. Oral NaFeEDTA or iron polymaltose supplements mitígate exposure to post-dose non-transferrin bound iron (NTBI), independent of iron status/gender.

**Abstract 1009**: Orozco MN, Romero-Abal ME, Solomons NW, Weiss G, Schümann K. The circulating non-transferrin bound iron (NTBI) response to 100 mg of ferrous sulfate is unrelated to iron status or gender.

**Abstract 2215**: Duffy TL Montenegro-Bethancourt, Arriaga C, Belosevic M, Solomons NW, Clandinin MT. The intensity, but not the prevalence of Giardia infection is associated with anthropometry in rural Guatemalan day-care centers.

**Abstract 3893**: Chomat AM, Crowley C, Montenegro-Bethancourt G, Solomons NW, Bermúdez O. Feeding practices during pregnancy and early lactation among Mam-speaking women in the western highlands of Quetzaltenango, Guatemala.

**Symposium Tackling iron deficiency and anemia in infants and young children in malaria-endemic areas: Moving from controversy towards guidance for safe, effective and feasible policies and programs**. Crowley C, Solomons NW, and Schümann K.

# Images of CeSSIAM´s Anniversary Year

Dr. Solomons during the 2010 National Science and Technology Medal award ceremony at the Congress of the Republic of Guatemala.

CeSSIAM´s staff members with Dr. Solomons during the award ceremony.

Drs. Colleen Doak, Klaus Kraemer and Marieke Vossenaar during CeSSIAM´s anniversary brunch in Oporto, Portugal

CeSSIAM´s staff during CeSSIAM´s anniversary brunch in Oporto, Portugal

Dr. Odilia Bermudez during the Friends of CeSSIAM breakfast at EB 2010


Ms. Devika Suri and Prof. Ricardo Uauy of the Nevin Scrimshaw Intenational Nutrition Foundation at the Friends of CeSSIAM break-fast at EB 2010