

CABELLO PALIDO
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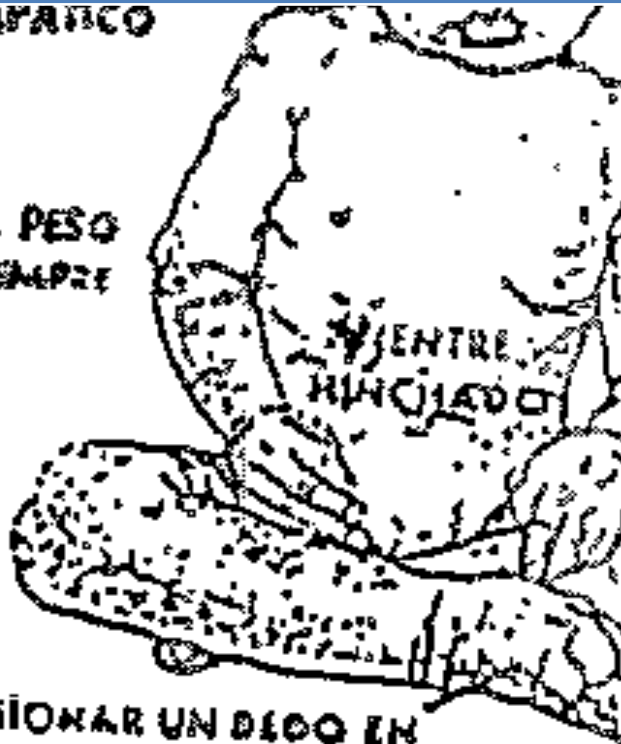


2011

The Holistic Process: Battling Kwashiorkor

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AGSC 465 Health, Poverty, and Agriculture

12/15/2011

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About the Author:

A senior at Montana State University, majoring in Environmental Studies, Alex M. Martens has been fascinated with the social-cultural trends within different communities. Heavily weighted by environmental and ecological issues, Alex incorporates a naturalistic opinion and subtle point of view within his research. Born and raised in southern Idaho, Alex enjoys his time outside and has a passion for cooking.

Abstract:

The problem being addressed is that children in the village of Sanambele aren't receiving sufficient amounts of Tryptophan and Lysine in their diets. The research following gives insight into proper breastfeeding techniques associated with premature weaning and less than required weaning behaviors. With the beginning process of weaning the child needs certain specified amounts of the missing Tryptophan and Lysine. By using Bambara groundnuts as a staple in the children's diet, efficient amounts of these essential amino acids will be returned to the child post weaning.

Introduction:

People located everywhere all over the world have obstacles that need to be overcome. It's just a matter of pinpointing a problem, then gathering brilliant minds with motivation, and the will to fight to overcome a specified problem. Mali, a butterfly shaped country located in West Africa, contains a small village which withholds around 1,200 people. This peaceful village flourishes with rich cultural wealth and pride. It is clear to see that there are surface problems that are devastating not only this continent, i.e. political corruptness, poverty stricken communities peppered throughout the lands, and religious indifferences among neighbors, but

these same surface problems affect third worlds all over the globe. There is however a silent killer within smaller villages in Africa. Without a strong economic holdfast, villages are subject to disease and famine. This is a current problem in our village of focus, Sanambele.

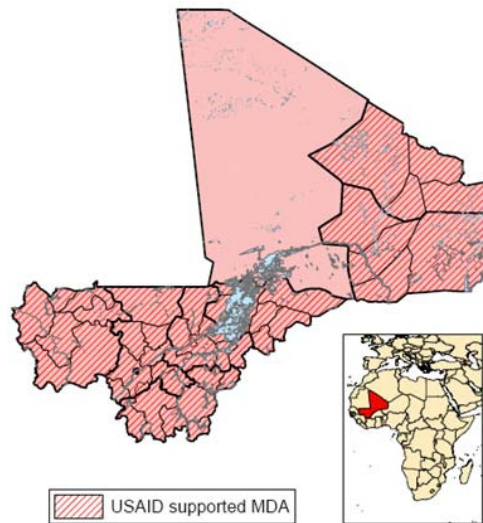


Figure 1:

View of Mali in correlation to Africa (<http://aznewsfeed.com/wedge-malinda-harris-of-kennett/>)

Sanambele is a place in the world where cultural wealth and identity are an important way of life. The community is more tightly knit together than expected, and there is certain “closeness” that we do not see often in America. People of Sanambele seem to live every moment of life as a precious treasure, and wring out every last drop of each day spent on earth interacting with each other. From the moment the sun rises and casts its warmth upon the land, the well tuned Sanambeleans respond to the works of nature and begin to work themselves. These people work every day, all day long, because work is an important part of their daily routine. Sanambele inhabitants seem to have strong material pride, however, not in the same way we as Americans think of material pride. Sanambeleans put their work directly into the materials they need for survival. Hours of labor go into crops in the fields, making necessities for living, i.e. clothing, utensils, shelter, mechanisms for retrieving water, and other aspects of daily

conveniences. Kneading and shaping mud into pots and firing them in piles of wood to harden the product of earth into a material good provides a great example of development. These materials primary purpose isn't to reflect the community's cultural identity, even though the products made are beautiful and unique; they are to serve a more crucial purpose. These pots are a form of education and technology. Disease and infection are more prominent in third world countries, but with the use of these pots, Sanambeleans are able to keep unwanted rodents and moisture out of the grains harvested for nourishment. This sign of development promotes encouragement from Americans in order to assist Sanambeleans for achievement of their holistic goal.

Everything one needs to know about a community lies within how a community is viewed. Upon the arrival to Sanambe, one sees mud huts draped with woven grass roofs, scrap metals peppering structures in need of patchwork, asphalt is a fallacy, labor replaces the convenient twisting lever for water, electricity is sparse, bathing at the end of a hard day of work is a privilege, and relief from the sun's beating rays lies within a rhythmic of the wrist and a woven fan. For most westerners, this community would be seen as a poverty stricken place. When taking the time to examine this place, one finds clean air, little to no litter, people wearing smiles as an official uniform for work, and a lulling of conversation and cheerful laughs. It would seem that the level of material poverty is high, others tend to disagree. A community that copes with the resources provided from the grounds which they walk, has everything needed to reach equilibrium. It is just a matter of harnessing the power, and transforming it to correlate with the needs of the people; this is a key component to achieving a holistic goal.

The holistic goals that affect these communities are usually tied to a better way of living. The last holistic goal we aided the Sanambeleans with was the war against Malaria. This was

achieved by observing a problem being faced with the Sanambeleans, combining thoughts, views, and moral standards, and applying them to the problem in order to abolish it. The important thing to keep in mind when assisting others for a holistic goal is that in order to be successful, there needs to be equality when facing a problem. There cannot be a dominant party when resolving issues. One party needs to listen to the other's needs and wants, and then develop a method to be used. We should go into this with a clear open mind, and use our subjects as a means to an end. This will help immensely considering the local tribes will have a better idea how their land works and reacts; also their traditional wisdom of the land can provide shortcuts that save time by driving through ideas to a solution.

Hypothesis:

This hypothesis was developed in accordance to administering efficient levels of the missing amino acids back into the diets for African children, and ultimately conquering kwashiorkor. "The Bambara Groundnut is the best option for a plant source of tryptophan and lysine for newly weaned children."

Materials and Methods:

In order to complete my research, I have looked at many articles and research papers. The research included is mainly from predecessors and other researchers. Interviews with Dr. Florence Dunkel and Keriba Coulibally were also conducted for general information regarding the community itself. Most of the articles are directly associated with Mali, while others were based on studies throughout Africa, and some outside of Africa. After sifting through many articles I was able to find many that contribute to my research.

Table 1:

Resources found on the internet

DATA BASES	KEYWORDS	HITS
CAB Direct	bambara groundnut	8
CAB Direct	Bambara Groundnut	418
CAB Direct	Tryptophan development	3700
CAB Direct	Weaning from breastfeeding	223
CAB Direct	Bambara Groundnut tryptophan levels	0
CAB Direct	Bambara Groundnut Tryptophan	1
CAB Direct	Tryptophan needed for infants	23
CAB Direct	Tryptophan in Bambara Groundnut	210
CAB Direct	Sanambele uses for Groundnut	0
CAB Direct	Bambara Groundnut growing season	8
CAB Direct	Bambara Groundnut in North Africa	9
CAB Direct	Bambara Groundnut in Mali	8
Google Scholar	Tryptophan levels in Bambara Groundnut	153
CAB Direct	Sanambele	0

CAB Direct	West Africa	106214

Results:

Our holistic goal is based on kwashiorkor. First the problem needs to be addressed, and then methods according to the villagers need to be implemented into a solution. This disease is due to a protein deficiency that usually occurs within small children that are newly weaned or children that just aren't being supplied with the essential amino acids needed for emotional, mental, and physical development. The culprits for this disease are tryptophan and lysine. In times past, these villages had access to tryptophan, which aids in the body in producing serotonin, auxin, and niacin, in the resources of grasshoppers, however, currently there are pesticides being used on the cotton crop which eliminates the tryptophan available for consumption (Gause PSPP 465, 2011). Children that are still being breastfed are supplied these essential amino acids, but as soon as they are weaned from the mother, they are cut off from these essentials for life. The weaning period is described as the period of transition from an exclusively milk diet to complete range of foods taken by the adult section of the community and also, a weaning food should be accessible to the child and should be adequate in protein, fat, carbohydrate, vitamins, and minerals to alleviate protein-energy malnutrition (Adebayo-Oyetero et.al. Yaba, College of Technology, Nigeria). This is a crucial period in the child's life, and once weaned from the mother, the child needs to have access to all necessary nutritional values. It is not only the local villagers challenge but also our own challenge to conquer the kwashiorkor

epidemic and stop it dead in its tracks. According to the Journal of Human Lactation, 43% of US infants are breastfeeding to any degree at the age of 6 months, and only 13% meet the recommended 6 months of exclusive breastfeeding. By 12 months, less than 23% are still breastfeeding (Rebecca Mannel J Hum Lact, 2011). If the US is lagging behind in this aspect, think of how Africa is doing. Another issue in Africa is the education and professional help aspects. Many times in the states, new mothers often do not seek professional help associated outside of the hospital. This leaves the mother and child vulnerable to improper breastfeeding techniques. Lactation initially starts during pregnancy; the onset of breastfeeding occurs after birth and is dependent on two patients, mother and child. Breastfeeding is a complex process that depends on many acute factors. Timing for breastfeeding is essential and required optimal conditions for the mother, including: physiology, delivery complications. Another aspect to be accounted for is environmental, i.e. separation of mother and child and delayed initiation of milk expressions. Breastfeeding is also affected to timing in the sense that delivery mode, knowledge associated with the mother, issues concerning psychological abuse. For the infant, physical status and birth trauma play a role in breastfeeding. Environmental conditions that greatly affect breastfeeding behaviors include the opportunity to latch within the first hour of birth, skin to skin contact, the separation of healthy mother-baby couplets, and routine formula supplementation play a role in breast milk expressions. Lactation is a very sensitive physiologic state, physically demanding, and its long term maintenance depends on the action of breastfeeding or continued milk removal (Rebecca Mannel J Hum Lact, 2011). There are many different levels for defining how the mother-child breastfeeding occurrences are from a healthy standpoint. See Table 1, which shows the different levels of lactation acuity, and the signs associated with lactation acuity.

Table 2: Lactation Acuity Levels

Acuity level 1	Level 1 acuity patients can be cared for by nursing staff that have basic breastfeeding knowledge and competency.31-33
Maternal characteristics	<ul style="list-style-type: none"> Basic breastfeeding education, routine management Latch/milk transfer appear optimal Maternal decision to routinely supplement Maternal decision to pump and feed expressed breast milk Maternal indecision regarding breastfeeding Mother can latch baby with minimal assistance Multiparous mother with healthy-term baby and prior breastfeeding experience
Acuity level 2	Level 2 acuity patients should be cared for by Registered Lactation Consultant staff as soon as possible, or referral made to Registered Lactation Consultants in the community. Early follow-up after discharge is critical.33-41
Maternal characteristics	<ul style="list-style-type: none"> Antepartum admission with increased risk of preterm delivery37,38,42 Caesarean section delivery12,43,44 Delayed breastfeeding initiation (defined as after 1 hour with routine vaginal delivery and after 2 hours with routine cesarean section)2,3,43 Maternal acute illnesses/conditions (eg, preeclampsia, cardiomyopathy, postpartum depression, postpartum hemorrhage)38-40 Maternal age (mother < 18 years or > 35 years)40,41 Maternal chronic conditions (eg, rheumatoid arthritis, systemic lupus erythematosus, hypertension, cancer, history of gastric bypass, obesity)38,45,46 Maternal cognitive impairment (eg, mental retardation, Down syndrome, autism)38,41 Maternal endocrine disorders (eg, polycystic ovary syndrome, infertility, thyroid disorders, diabetes)38-40 Maternal medication concerns47 Maternal physical disability (eg, paraplegic, cerebral palsy, visual impairment, psychiatric)38,40 Maternal readmission (eg, breastfeeding well established, noncritical issues)38,40 Maternal request48 Multiparous mother with history of breastfeeding difficulty37,38 Primiparous mother or first-time breastfeeding mother with healthy-term baby49,50

	Social/cultural issues (eg, communication barriers, domestic/sexual abuse)41,51,52
Infant characteristics	Consistent LATCH score < 6 at day of discharge53,54 Breastfeeding Assessment Score \leq 527,28 Latch difficulties (eg, pain)37-41,55 Infant readmission (breastfeeding well established, noncritical issues)38,40 Newborn birth trauma (eg, cephalohematoma, shoulder dystocia)12,56 Suboptimal/inadequate milk transfer leading to medical recommendation to supplement5,37,57
Acuity level 3	Level 3 acuity patients need to be cared for by Registered Lactation Consultant staff while in hospital. These patients will require in-depth assessment and ongoing management. Early follow-up after discharge is critical.33-41
Maternal characteristics	Abscess/mastitis37,58 High maternal anxiety38,48 Induced lactation5,38,40 Maternal breast conditions (eg, breast/nipple anomalies, glandular insufficiency, history of breast surgery)8,38,56 Maternal illness/surgery38,40,59 Maternal readmission (breastfeeding not well established and/or critical issues)38,40 Pathologic engorgement8,60
Infant characteristics	High-risk infant on mother-baby unit (eg, late preterm, small/large for gestational age, multiples)5,8,61-63 Hyperbilirubinemia64-66 Hypoglycemia67 Infant admission to neonatal intensive care42,68 Infant congenital anomalies38,69,70 Infant illness/surgery8,38 Infant oral/motor dysfunction (eg, tight frenulum, hypotonia/hypertonia)70-72 Infant readmission (breastfeeding not well established and/or critical issues)38,40,41 Infant weight loss > 7% of birth weight before discharge8,73.

-Acuity levels can change on the basis of assessment by the Registered Lactation Consultant or other health care team members.

When one knows what to look for, it is easy to spot early and severe signs of kwashiorkor. These symptoms can be as mild as a reddish hue to hear color, to severe as a protruding belly with muscle mass loss, and also include: changes in skin pigment, diarrhea,

failure to gain weight and grow, fatigue, increase and more infections due to damaged immune system, irritability, lethargy or apathy, rash, shock, and swelling (A.D.A.M. Atlanta, 2011).

Kwashiorkor is usually found in areas that suffer from famine, a limited food supply, and a lack of education in accordance to proper dieting. Treating kwashiorkor is as simple as providing children with more calories and protein; this is only during early stages of kwashiorkor. If the kwashiorkor severity is too prominent, more advanced steps need to be taken. The patient will need calories in the forms of carbohydrates, simple sugars, and fats. This provides energy so then the proteins can be administered to the patient (A.D.A.M. Atlanta, 2011). So a good question we have to ask ourselves is, what other food source, besides insects introduced with pesticides, can be administered so that these children will not lack essential amino acids, tryptophan and lysine?



Figure 2:

African Children living with kwashiorkor (<http://drugster.info/ail/pathography/151/>)

Protein foods, typically animal proteins, have continued to be in short supply in the diets consumed by a large segment of the population in developing countries. In many of these countries like Nigeria, traditional sources of animal proteins obtained from game or wild animals as well as the domestic production of animal products are prohibitively expensive. Legumes are

some of the low priced sources of protein rich foods that have been important in alleviating protein malnutrition (Aykroyd et al., 1982). Groundnuts are a leguminous plant that is grown and harvested all throughout Africa and in parts of Latin America. It is important in the fact that Groundnut is grown in sub-Saharan Africa, and is the focus of my research. The origin of the Bambara groundnut is in West Africa, and represents the third most nutritious legume in semi-arid Africa. It is able to thrive in high temperatures, and has little demand for soil quality. There are 3 to 4 months from June to September that receive about 45 inches of rainfall yearly. May is typically the driest month. This plant has many specialized attributes that help it thrive in the most severe periods of drought. The Bambara groundnut can grow up to 50+ nodules, which reside in the upper 5 to 15 cm of soil, and are subject to drying out during times of drought. However, when a period of drought is upon the region, the nodules of the Bambara groundnut are able to penetrate soil to retrieve water from lower soil zones (Madukwe D. K. et al Department of Crop and Biotechnology, 2011). Studies by Madukwe et al, for the Department of Crop Science and Biotechnology at Evan Enwerem University in Nigeria, show that the Bambara ground nut favors ideal conditions of 500 ml of water per day. Studies included 36 plastic buckets each with Bambara groundnuts sewn within the pots. The buckets were subdivided into three groups of 12. Four water level treatments were done. The first group (control) was watered 500ml once daily, the second was watered 500ml every four days, the third was watered 500ml once in seven days, and the fourth received 500ml once during 14 days. 100% germination took place within seven days in the control plots; this by far was the shortest. The control did not produce the highest number of leaves per plant; however it was not statistically significant from the other plots with different watering methods. Nodule count on the control was the greatest at 40 days after planting (DAP), at 50.0 nodules per plant. 11.74

nodules per plant were the lowest at 40 DAP, and were found in the pot where 500ml of water was applied once within a 14 day period. The control pot showed to have the best conditions for Bambara groundnut growth. These ideal conditions would not likely occur in a place where water is in limited supply. Temperatures in this region range anywhere from 60 degrees F to 102 degrees F (16 degrees C to 39 degrees C). The soils of Mali are mostly rich in clay deposits, of which the farmers utilize to make pots and urns, and are moderately productive labeled by the British Commonwealth Agency (Gause PSPP 465, 2011). This legume also is a nitrogen fixer. This comes from the symbiotic relationship between legumes and rhizobium, of which the process is strongly relied on the host plant. This is useful for agricultural techniques such as intercropping. Intercropping is a process of planting two different crops together in the same plots. Typically the seeds are harvested, then either be eaten raw, boiled, or ground into flour. Mali has the second highest harvest in Africa with 28,000 area harvested (ha), a yield of 750 (kg/ha) and a 21,000 ton production annually. Besides playing an economic role within African communities producing this prized crop, there may also be some hidden benefits to this legume.

One of the main contributors to kwashiorkor is a lack of micro-nutrients. These micro-nutrients include Mn, Zn, Fe, and Cu. These minerals fluctuate depending on the methods of preparing two different species of the Bambara groundnut (KAB-3 and Oturkpo local). In a study done by D.F. Apata (Department of Animal Production) and A.D. Ologhobo (Department of Animal Science) for the University of Ilorin, Ilorin, Nigeria; raw, cooked, and autoclaved Bambara groundnuts were measured for their micro-nutrient content. Mn levels were highest in raw Oturkpo local Bambara groundnuts at 18.4 mg/kg DM. Raw KAB-3 Bambara groundnuts held higher levels of Zn at 29.2 mg/kg DM. Cooked KAB-3 Bambara groundnuts had the higher amount of Fe at 48.1mg/kg DM. Cu levels showed to be highest when the Oturkpo local

Bambara groundnut is autoclaved at 5.5 mg/kg DM. As far as lysine content is concerned raw KAB-3 showed to have 6.57 g/16g N, whereas Oturkpo local had 6.83 g/16gN. Oturkpo local had the third highest level of lysine in this study, better alternatives would be Pondo-6 Kidney beans (7.35g/16gN) and TPL 249 Lima beans (6.90 g/16gN). Tryptophan levels were higher in the KAB-3 Bambara groundnuts at 1.31 g/16gN. Oturkpo local Bambara groundnuts had 1.19 g/16gN. These levels were on the higher end of the spectrum only to be surpassed by Pondo-6 Kidney beans (1.44g/16gN).

Studies by D.F. Apata and A. D. Ologhobo have shown that in 100g of Oturkpo local raw Bambara groundnuts 21.4% makes up crude protein. The amino acid pools within the 21.4% crude protein have 6.83g/16g N of Lysine and 1.19g/16g N of Tryptophan. Crude protein is expressed using $(N \times 6.25)$, so in order to find out how much Lysine and Tryptophan are in raw Bambara groundnuts and we need to apply crude protein to g/16g N. This equation is as follows: 21.4% is divided by 6.25g N, which equals 3.424g N in 100g of raw Bambara groundnuts. 3.424 is then multiplied with our original amount of Lysine (g/16g N), and then divide by 16g N. This gives us 1.46162g of Lysine, or 1461.62mg Lysine per 100g of raw Bambara groundnuts. Using the same formula we can replace levels of Lysine with levels of Tryptophan. Once done we receive a value of 235.62mg of Tryptophan per 100g raw Bambara groundnuts. How can we make sense of these numbers? Children from ages 1-3 require 45mg Lysine/ (kg bodyweight)/ day. This same age group required 6mg Tryptophan/ (kg bodyweight)/ day. Children ages 4-8 require 37mg Lysine/ (kg bodyweight)/ day, and 5mg Tryptophan/ (kg bodyweight)/ day. A 2 year old infant would weight an estimated 12 kilograms, and would require 540mg of Lysine and 72mg of Tryptophan per day. With the data presented it is clear that raw Bambara groundnuts are sufficient in appropriate levels of both Lysine and Tryptophan.



Figure 3:

Picture of the Bambara Ground Nut (Vigna subterranea)
(http://www.nap.edu/openbook.php?record_id=11763&page=52)

Conclusion:

Vigna subterranea and *Voandzeia subterranea* are readily available in the area of focus and are already part of the Sanambelean diet, but as a treat, not an important food source. There are efficient levels of the essential amino acids; they just need to be administered in a higher portion to the newly weaned children of the village. Ultimately the decision resides within the elder council. They decide whether or not Bambara groundnut consumption should be increased within the diet. As stated previously, ideal conditions of 500ml of water administered once daily results in better development and seed yield of the Bambara groundnut. Agricultural development would dramatically increase the yield of this cash crop which in turn could

potentially be used for trade of other goods, not to mention the abundant increase in Bambara groundnuts to be distributed throughout the village. The next step for us to complete would be developing a strategy that coincides with the village elders about establishing this idea of using this cash crop more steadily in the Sanambelean diet. This holistic process represents more of a relationship that exists between people. We need to make clear presentations about our main points and research and incorporate input from our counterparts. We hope to see this action underway, kwashiorkor as a depleted past even, and great results arise from the inhabitants of Sanambele.

Recommendations:

- Realize the importance of the holistic process and community involvement.
- Understand that keeping an open mind, and knowing that one needs to tread lightly while in an unfamiliar culture, is important because respect ultimately creates ease when dealing with a cognitive dissonance.
- Diagrams work well, especially if there is a language barrier conflicting with words and ideas.
- Understanding the land and learning about traditional ecological knowledge is a key tool when dealing with an agricultural resource.
- Do not lose sight in what is the important goal is. Getting caught up and developing a cycle could be a waste of time if it does not satisfy the wants and needs for the community of focus.
- Collaboration of research with fellow students could result in new and improved ideas to be presented to the community of focus.

- Monitoring is a crucial component of this project. We must follow this project until it has completely taken flight, and no longer requires additional monitoring provided by Montana State Researchers, students, and fellow researchers involved in this goal.

Acknowledgements:

Very special thanks to the following predecessors and professionals involved in the forward movement of my research;

Dr. Florence V. Dunkel, Associate Professor of Entomology, Department of Plant Sciences and Plant Pathology, Montana State University-Bozeman

Kathryn Gause, former PPSP 465 student, Montana State University-Bozeman

Keriba Coulibaly, tenured scientist in Plant Breeding, L'institut d'Economie Rurale.
Sikasso, Mali

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