Semi-Annual Report for

Feed the Future Innovation Labs for Food Processing and Post-harvest Handling

April 30, 2015

Management Entity Information

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Technical Committee

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List of Countries Where We Work

Kenya and Senegal

List of Program Partners[1]

USA: North Carolina A&T State University
Kenya: University of Eldoret; The Cooperative University College of Kenya; and CIMMYT, Kenya
Senegal: Institut de Technologie Alimentaire and Institut Senegalais de Recherches Agricoles.
Others: University of Pretoria, South Africa and A to Z Textiles, Tanzania.

[1] U.S. universities and international partners by country.

Acronyms

AC	Advisory Council
CUCK	The Cooperative University College of Kenya
DV	Dietary value
EAR	Estimated Average Requirements
FGD	Focus Group Discussion
FPL	Innovation Lab for Food Processing and Post-harvest Handling
ISRA	L'Institut Sénégalais de Recherches Agricoles
ITA	Institut de Technologie Alimentaire
NC A&T	North Carolina A&T State University
PICS	Purdue Improved CROP Storage bags
SC	Steering Committee
SOPs	Standard Operating Procedures

I) Executive Summary

The Food Processing Innovation Lab, awarded on May 19, 2014 will be concluding its first year of operations in a few weeks (May 18, 2015). The goal of the project is to increase access to safe and nutritious foods along the value chains by improving the drying and storage capacity of smallholder farmers and expanding market opportunities through diversified processed products that address quality in the market and nutritional needs. The program focuses on cereals and grain legume value chains in Kenya and Senegal. Locally available nutrient-rich value chains are also targeted for enhancing the nutrition of processed products. The activities reported herein occurred mainly during the second half of the year; the first half of the year involved setting up of program management systems. Progress has been made in the following key project areas: 1) development of simple moisture determination methods; 2) assessment of market drivers for processed food products, with and without micronutrient fortification; and 3) collecting and archiving dried nutrient-rich plant sources including analyses for provitamin A, Iron, and Zinc, and establishing standard operating procedures for plant material procurement and handling. Year 2 work will build on the successes of year 1 in all four project component areas of drying, storage, food processing, and nutrition including optimizing and field testing developed technologies and continued research and development of new technologies. These efforts also provide a framework for capacity building and scientific exchange. As a main outcome this project seeks to produce technologies that are replicable, cost-effective, scalable, and commercially viable for smallholder farmers and food processors in Kenya, Senegal, and other Feed The Future countries.

II) Program Activities and Highlights[2]

- Baseline data collection in Kenya and Senegal
    - Identify drying, moisture measurement, and storage methods used by farmers and determine moisture content of grain stored by farmers
    - Assess market demand and drivers for processed food products, with and without nutritional enhancement
- Develop low-cost moisture determination methods and grain dyers
- Determine optimum grain moisture content for safe storage of grains in hermetic bags to reduce losses due to mold and insects damage

[2] Summary of program activities for the year, no more than one page in length.

- Conduct analysis of micronutrients content of local nutrient-rich plant materials collected in Kenya and Senegal
- Screen for micronutrient bioaccessibility (optimizing delivery) from model products - using both *in vitro* and *in vivo*
- Establish standard procedures (SOPs) for material procurement and handling related to micronutrient screening and product development
- Initiate establishment of Incubation Center at University of Eldoret in Kenya

III) **Key Accomplishments**[3]

- A prototype device for measuring grain moisture based on equilibrium humidity and temperature with digital temperature/hygrometer was developed. The moisture content is determined from a chart.
- A solar dryer concept designed to be a collapsible portable multipurpose unit is currently being analyzed to determine feasible and economic capacity, thermal collector configuration, thermal collector type, structure and material for contraction, drying basket design, and airflow mechanism.
- Experimental protocols for determining fungal species community associated with stored maize have been developed. The protocols rely on "next generation sequencing" method and informatics to identify and quantify fungal species.
- Market assessment studies have identified potential drivers for processed and nutritionally enhanced processed products among different socio-economic groups. They include: nutrition, cost, satiety value of products, convenience and energy-saving potential.
- Established standard procedures (SOPs) for material procurement and handling related to micronutrient screening and product development.
- A dataset of 30 distinct dried plant materials from Senegal and Kenya that have been screened for provitamin A and mineral content is available at Purdue. Select materials have been prioritized for further product testing including carrot, mango, and papaya for vitamin A, and baobab fruit, Lam (*Moringa sp*.), Oule, Nere, and Roselle (*Hibiscus sp.*) for iron and zinc content.
- 9 graduate students recruited: 6 male and 3 female; 6 Ph.D. and 3 Masters. The students are from Kenya, Nigeria, Ecuador and USA.

IV) **Research Program Overview and Structure**

The project has two core research components: 1) Grain drying and storage involving development and dissemination of affordable and efficient drying and storage technologies for use by smallholder farmer, and 2) Food processing and nutrition involving development of high quality, market-competitive food products, including products with improved nutrition and dissemination through incubation training centers. Building of local capacities (human and institutional) and partnerships among public and private sector are also major components of the project. Gender and environment are taken into account at all stages of the project cycle.

[3] Concise statement of achievements, limited to one page in length that focuses on outputs, not process, such as Feed the Future indicators and distillation of program achievements across all program activities. Reporting on numbers of project meetings is not an output.

V) **Research Project Reports**[4]

a) Theme A: Drying & Storage (Improve moisture measurement, drying, and storage of cereals and grain legumes in the humid tropics of Africa)

i) Project 1

(1) Name: Grain dryers and moisturemeters development

(2) Description: Development of grain dryers and moisture content determination methods for dried grain.

(3) Collaborators[5]: Klein Ileleji (lead), Charles Woloshuk, Jess Lowenberg-DeBoer, Corinne Alexander & Jake Ricker-Gilbert (Purdue, USA); Douglas Shitanda (CUCK, Kenya); Hugo DeGroote (CIMMYT, Kenya); Makhtar Samb (ITA, Senegal); Ibrahim Sarr & Katim Toure (ISRA, Senegal); Guibing Chen (NC A&T, USA); Cheryl O'Brien (San Diego State University, USA)

(4) Achievements:

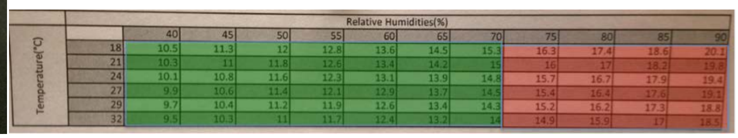
(a) **Development of simple grain moisture methods:** A prototype device for measuring grain moisture was developed by an FPL graduate student at Purdue (Figure 1). The device measures equilibrium humidity and temperature with digital temperature/hygrometer, which is used to obtain moisture content from a chart. A second version of the device uses a humidity strip (color-indicator) that provides user information on safe moisture levels for storage. The device was demonstrated to farmer and extension agents during our visit to Kenya (February 2015); their responses were enthusiastic. FPL researchers (Drs. Ileleji and Chen) are developing a simple method to determine grain moisture content based on the volume change in kernel versus changes in moisture content. Tests done at Purdue indicate that kernel apparent density was negatively linearly correlated with moisture content. For each percent point change in moisture, there was a 0.21% change in kernel density. A similar test at NCA&T showed a small change in kernel density with moisture content. If the volume change with moisture content is known, and the number of kernel per volume is determined, then the relationship between numbers of kernels per volume change with moisture is used as an indicator of the moisture content. This will provide a simple method based on counting the number of kernels that fit a given small volume. The goal will be to develop a calibration for the number of kernels per volume for 13% moisture (wet basis) as the threshold, above which grain has a high risk of storage in the humid tropics. Aspects that will be considered are the effect of maize hybrid and minimum volume at which the method is most able to distinguish differences in moisture content at the 13% moisture threshold level. Other simple grain moisture methods pursued by Ileleji include the use of salt (NaCl) to determine unsafe moisture content in maize.

(b) **Development of grain dryers**: FPL drying and storage team, the gender expert, and local partners visited Kenya in February 2015. The purpose of the trip was to learn about farmers drying practices and challenges. They also interviewed farmers, millers, and processors to learn about gender-specific roles in these activities. Dr. Ileleji and his team are working on two crop dryer designs, a portable solar dryer and a drying stove, with the goal of testing both designs at Purdue in Summer 2015 in preparation for field testing at research stations in Kenya and Senegal in Fall 2015.

[4] Summaries of project activities, highlights and outcomes, not scientific reports or long detailed research papers, no more than one page per project.

[5] Provide institutional affiliation and country.

The solar dryer concept is designed to be a collapsible portable multipurpose unit is currently being analyzed to determine feasible and economic capacity, thermal collector configuration, thermal collector type, structure and material for contraction, drying basket design, and airflow mechanism.



Temperature(°C)	Relative Humidities(%)										
	40	45	50	55	60	65	70	75	80	85	90
18	10.5	11.3	12	12.8	13.6	14.5	15.3	16.3	17.4	18.6	20.1
21	10.3	11	11.8	12.6	13.4	14.2	15	16	17	18.2	19.8
24	10.1	10.8	11.6	12.3	13.1	13.9	14.8	15.7	16.7	17.9	19.4
27	9.9	10.6	11.4	12.1	12.9	13.7	14.5	15.4	16.4	17.6	19.1
29	9.7	10.4	11.2	11.9	12.6	13.4	14.3	15.2	16.2	17.3	18.8
32	9.5	10.3	11	11.7	12.4	13.2	14	14.9	15.9	17	18.5

Figure 1. Prototype moisturemeter that uses humidity/temperature devices

(5) Capacity Building: Two PhD students were admitted: Stacy McCoy (USA) in Agriculture Economics (Fall 2014) and Ravindra Shrestha from Nepal in Agricultural and Biological Engineering (January 2015). A potential PhD student, Michael Mukolwe, has been identified to be admitted at CUCK, Kenya in August 2015. He is currently developing a prospectus to address farmer challenges based on initial interviews conducted in Kenya. An M.S. student, Timothy Tubbs (USA), is also working on the project at Purdue (Fall 2014).

(6) Lessons Learned: Drying is a challenge for farmers, especially during the main cropping season where the harvest occurs in the month of August and coincides with rains. Gender roles in post-harvest segment of the value chain are very complex; a survey will not be sufficient to capture this complexity. Team is exploring opportunities to conduct gender focus group discussions.

(7) Presentations and Publications: An abstract has been submitted for a poster presentation at the annual meeting of the American Phytopathological Society (August 2015) entitled: Simple Devices for Determining Grain Moisture, by Timothy Tubbs and Dr. Charles Woloshuk.

ii) Project 2

(1) Name: Grain storage

(2) Description: Storage methods in Senegal and Kenya – Begin to identify storage methods used and assess potential for aflatoxin development in hermetic bags

(3) Collaborators[5]: Jess Lowenberg-DeBoer (Purdue, USA) (lead), Charles Woloshuk (Purdue, USA); Douglas Shitanda (JKUAT, Kenya); Hugo DeGroote (CIMMYT, Kenya); Makhtar Samb (ITA, Senegal); Ibrahim Sarr (ISRA, Senegal)

(4) Achievements:

(a) Experimental protocols have been developed for determining fungal species community associated with stored maize. The protocols rely on "next generation sequencing" method and informatics to identify and quantify fungal species. These protocols will be used to document changes in fungal communities in maize stored by traditional methods and hermetic methods. Experiments are underway at Purdue to examine the impact of opening hermetic storage bags during storage. Farm families periodically open their 100 kg storage bags to remove grain for consumption. The experiments are examining effects of grain moisture coupled with the frequency of bag opening on the efficacy of storage in bags. Humidity, oxygen levels, fungal growth, and aflatoxin at several depths in the bags will be monitored over a 6-month period. Changes in fungal species within the grain by both classical and molecular methods are also being measured. We anticipate that the results will establish the level of risk for spoilage and aflatoxins accumulation from the practice of opening the bags.

(b) During the Kenya visit described in the drying section above, the Purdue and Kenyan team also interviewed the farmers and Extension officers about their storage practices. The team also visited with major maize buyers including the National Cereals Processing Board, and Unga Limited, which is the largest maize miller in Kenya to understand the financial motives for storing maize.

(5) Capacity Building: Two Masters Students, Timothy Tubbs and Brett Lane (USA), are working on storage projects. The team introduced the idea of Purdue Improved CROP Storage (PICS) bags to a group of Extension officers in Kakamega, Kenya who requested for a workshop to be conducted in August 2015.

(6) Lessons Learned: Kenyan farmers face storage challenges from the larger grain borer (locally called Osama) and dislike using chemicals, thus there is huge demand for hermetic storage such as PICS bags. We also learned that the National Cereals Processing Board pays a price above the local market at harvest which discourages storing for market sale; hence the primary motive for storing maize in Kenya is for home food consumption.

(7) Presentations and Publications: None

b) Theme B: Processing & Nutrition (Drive the value chain through processing to increase commercialization and improve nutrition)

i) Project I

(1) Name: Food processing

(2) Description: Assessment of market demand and drivers for processed and nutritionally enhanced products, and development of processes and products with potential for the marketplace.

(3) Collaborators[5]: Bruce Hamaker (Purdue, USA) (lead) & Mario Ferruzzi; Violet Mugalavai & Augostino Onkware (Eldoret Univ., Kenya); Djibril Traore (ITA, Senegal); John Taylor & Gyebi Duodu (University of Pretoria)

(4) Achievements:

(a) Kenya:

<u>University of Eldoret</u>: Dr. Mugalavai traveled to ITA, Senegal to learn about the Incubation Center concept and has begun establishing a similar Center at the university. The team at Eldoret has started developing a training manual that will be used at the Incubation Center and are in the process of procuring equipment for the Center. They have identified potential natural food fortificants, including the orange-fleshed sweet potato, cowpea, amaranth grain and leaves, carrots, pumpkin, baobab, and loquat, which will be process for nutritional enhancement. Nutritional analysis will be done at Purdue and Pretoria. Trials have been run on prototype baked and fried products. A survey of available composite cereal products (instant and non-instant) was conducted in Eldoret, Kenya. The instant weaning products that are liked by babies are imported (e.g., Nestle's Cerelac and Dannone's Purity) and are expensive. The products that are fortified by natural foods are also expensive. Some of the brands on the shelves have no indication of fortification.

CIMMYT: In April 2015, a team (G. Duodu, U. Pretoria; V. Mugalavai, U. Eldoret; B. Hamaker and B. Bugusu, Purdue U.; and H. DeGroote, CIMMYT) met in Nairobi and Eldoret (minus B. Hamaker) for a market assessment of processed cereal products and to understand potential drivers for nutritionally enhanced products among different socio-economic groups. Focus group discussions were organized in Nairobi and Eldoret with low- and middle-income women consumers. Most consumers consider nutrition, cost, and satiety value of products before purchase. The project will consider mid-low and high-end clientele targeted products.
A meeting was held with food processors in Nairobi. A list of food processors in the Nairobi area was established.

(b) Senegal:

Institut de Technologie Alimentaire (ITA): The team had already been working on commercially viable fortified instant local cereal products with high protein quality and high micronutrient bioaccessibility for porridge applications, and this work has continued in this period. Sensory analysis results showed good progress in terms of food preference, with millet instant porridge faring best compared to other local cereals (Figure 2). The Nestle brand (Cerelac) received the highest score and was significantly different from the other three. Millet received a score of 6.55, which is higher than the critical threshold of 6 that is indicative of marketability of a new product.
After the visit of US PIs (B. Hamaker and M. Ferruzzi) in February 2015, it was decided that the extrusion technology of the instant local formulas would be transferred to a local women entrepreneur (Mme. Mbacké) at Touba (a city in the interior east of Dakar) who has been trained through the ITA Incubation Center. Packaging bags have been designed, and an extruder will be placed at Touba in June or early July 2015. A trial was conducted on co-extruding papaya pulp with millet to a successful instantized product.

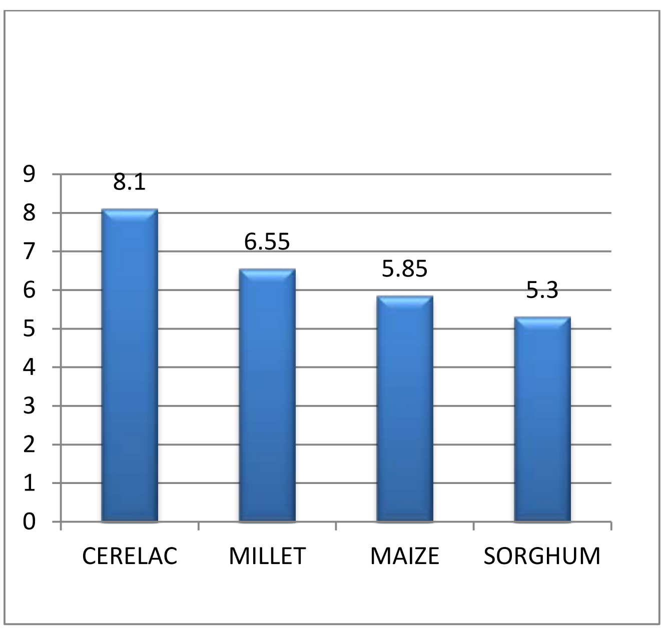


Figure 2. Customer food preference tests: Cerelac vs. blended millet, maize and sorghum.

(5) Capacity Building:
   (a) Four PhD students have been admitted in Food Science under FPL program: Pablo Cesar Torres-Aguilar at Purdue (Fall 2014), and Ayodeji Falade, Nokuthula Vilakati, and Adeoluwa Adetunji at University of Pretoria. All students are working to develop various products (fortified and non-fortified) and processes for the targeting the FPL focus countries. A potential PhD student, Emmanuel Ayua, from Kenya has been identified for admission at Purdue in January 2016.
   (b) In March 2015, Dr. Mugalavai underwent a one week training at ITA in Dakar, Senegal to get exposure on how cereal and legume processing is carried at the ITA Incubation Center, and how the facility is operated and managed.

(6) Lessons Learned:
   (a) Kenya:
   - Most processors and consumers require food processing and nutrition knowledge for a win-win situation: processors are interested in expanding their line of products while consumers are willing to try new products, including the instant products which are less time consuming, easy to prepare and nutritious, with high satiety value as long as they are not very expensive.
   - Not all the consumers care to check the label of purchased cereals to know whether they have been fortified.
   - Focus group discussions (FGD) - Nairobi: Many women consumers are interested in instant food; low-income groups because of fuel-use reduction and higher-income groups for time and convenience. Criteria for choosing cereal products are cost for low-income groups and nutritional quality and convenience for high-income groups.

   (b) Senegal:
   The economic couscous first developed at ITA didn't break through in the marketplace despite being liked by ITA personnel. The main cause seems to have been that the male entrepreneur chosen to disseminate the couscous throughout the country didn't have the infrastructure, as did the women entrepreneurs. In addition, it was the first time he entered the agro-food business and did not have adequate field experience. Under FPL program, economic couscous commercialization will be done using women entrepreneurs who have several years' field experience. Following their recommendation, the couscous will be further improved to match traditional couscous.

(7) Presentations and Publications: Influence of micronization (infrared treatment) on the protein and functional quality of a ready-to-eat sorghum-cowpea African porridge for young child-feeding. Vilakati, N., MacIntyre, U., Oelofse, A. and Taylor J.R.N. LWT Food Science and Technology (in press).

ii) Project 2

(1) Name: Nutrition

(2) Description: Screening of nutrient-rich plant materials for use in consumer based food products in Senegal and Kenya

(3) Collaborators[5]: Mario Ferruzzi (Purdue, USA) (lead); Violet Mugalavai & Augostino Onkware (Eldoret Univ., Kenya); Djibril Traore (ITA, Senegal); Johanita Kruger (Univ. Pretoria, South Africa)

(4) Achievements:
   (a) Purdue University:
   Collection and archiving of 30 distinct dried plant material from Senegal and Kenya was completed in Fall 2014 using established SOPs and FPL tracking forms. These materials

have been screened for provitamin A by High Performance Liquid Chromatography (HPLC) and mineral content by Inductively Coupled Plasma- Mass Spectroscopy (ICP-MS) methods. Select plant materials have been prioritized for further product testing including carrot, mango, and papaya for vitamin A, and baobab fruit (*Adansonia digitata*), Lam (*Moringa oleifera*), Oule (*Parkia biglobosa*), Nere (*Parkia africana*) and Roselle (*Hibiscus sabdariffa*) for iron and zinc content (Table 1). These data are being added to our current provitamin A data in our database and will be leveraged in selection of materials for current and future product development efforts.

Table 1. Concentration of iron and zinc in select African native plant materials collected in 2014-2015. Data represent the mean from 3 independent analyses by ICP.

	Mean	
	Analyte Name	
	Fe	Zn
Sample Name	Concentration (mg/g)	Concentration (mg/g)
Baobab	0.120	0.000
Bouy (10)	0.117	0.000
Bouy (11)	0.020	-0.010
Ipomoea b.	0.010	-0.007
Lam	0.240	0.003
Mango	0.010	-0.010
Nere	0.263	0.000
Oule	0.113	0.000
Peach Palm flesh	0.010	-0.010
Peach Palm peel	0.020	0.000
Roselle	0.073	0.048

Building on previous efforts, product formulation work on thin porridges has been based on millet/sorghum and dried plant materials. Our focus in Year 1 has been extensively on stability and bioaccessibility of provitamin A (Purdue). The bioaccessibility of thin porridges formulated with differing levels of pregelatinized sorghum/millet flour, fruit/vegetable blend and milk powder were assessed to determine the impact of formulation on carotenoid bioaccessibility in our three-stage *in vitro* digestion model. Initial results suggest that bioaccessibility for provitamin A carotenoids is poor (3-14%), (Figure 3). Presence of milk protein had a modest negative effect on carotenoid bioaccessibility. Despite low relative bioaccessibility, thin porridges were able to deliver 17.3-24.7% Estimated Average Requirements (EAR) for Vitamin A from a 200 g serving (Figure 4).

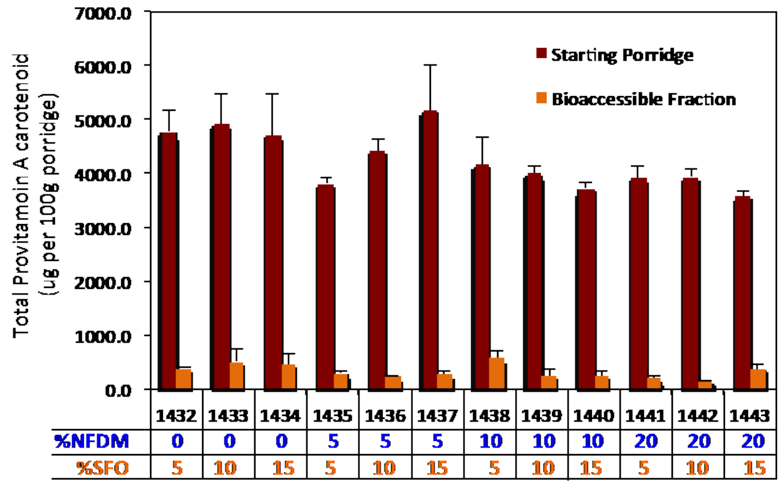


Figure 3. Levels of provitamin A carotenoids in test porridges formulated with sorghum, millet, dried carrot, dried mango, and variable levels of nonfat dried milk and sunflower oil.

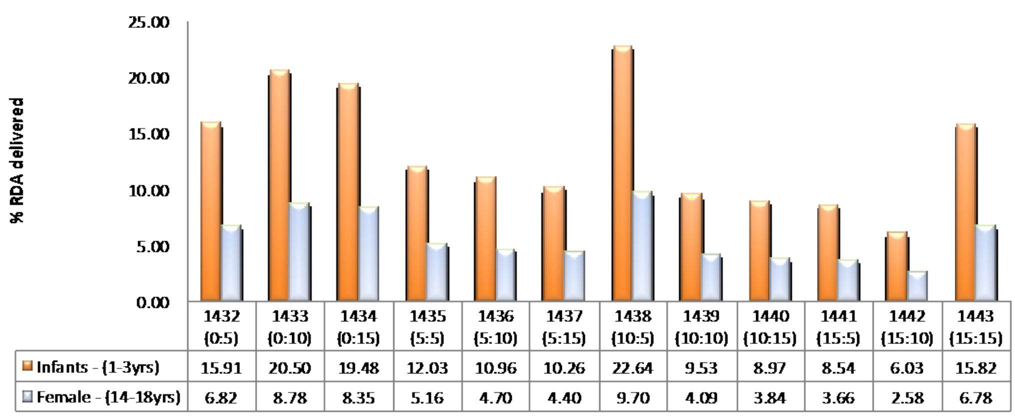


Figure 4. Percent of the vitamin A EAR to be delivered by a 200g serving of experimental porridge described in Figure 2.

Biofortified millet (Fe and Zn) developed by HarvestPlus in collaboration with ICRISAT is being sourced for exploration of optimal milling conditions for preservation of mineral content and for use as a base in product prototypes. Biofortified maize from Harvest Plus is currently being evaluated for provitamin A stability through extrusion and in storage. We have also initiated work in the co-extrusion of fruit materials with cereal to enhance bioaccessibility and stability of provitamin A carotenoids as well as iron and zinc. Results are expected in Year 2.

Finally, product development efforts will be driven by ongoing consumer insight studies in Kenya (March 2015) and Senegal (May 2015) to better understand the role of nutritional product characteristics in consumer preference.

(b) University of Pretoria:
Dr. Kruger is undertaking two studies to determine the impact of different micronutrient-rich vegetables on iron and zinc bioaccessibility in cereal porridges:

1) The impact of different green leafy vegetable dishes on iron and zinc bioaccessibility from maize porridges, with or without micronutrient fortification.
2) The impact of green leafy vegetables, orange fleshed sweet potato, and fat on iron and zinc uptake from porridges made from different types of sorghum.

(5) Capacity Building: One Master's student (John Gwamba) has been admitted at University of Pretoria.
(6) Lessons Learned: Achievement of greater that 20-25% dietary value (DV) for vitamin A is possible with native fruits and vegetables, but delivery will require assessment of processing to enhance bioaccessibility. Leveraging of biofortified millet will enhance the ability to deliver on iron and zinc product content. Furthermore, select plant materials such as Hibiscus and Bouye appear to be good candidates for co-formulation for iron and zinc. Exploration of co-extrusion of cereal and plant materials may be required to: 1) minimize the need for drying capacity, and 2) enhance the bioaccessibility of minerals in millet and carotenoids from fruits.
(7) Presentations and Publications: None

VI) Associate Award Research Project Reports: N/A
- a) Name of Mission and Award Number
  - i) Project Description
  - ii) Collaborators
  - iii) Achievements
  - iv) Capacity Building
  - v) Lessons Learned
- b) Name of Mission and Award Number

VII) Human and Institutional Capacity Development[6]
- a) Training by Country
  - i) Short-Term: Kenya
    - (1) Trainee: Violet Mugalavai, PI, University of Eldoret, Kenya (female)
    - (2) Purpose: To learn about the Incubation Center concept and develop a plan for establishing a similar Center at the University of Eldoret.
    - (3) Home institution: University of Eldoret
    - (4) Training institution or mechanism: Institut de Technologie Alimentaire (ITA) in Dakar, Senegal
  - ii) Long–Term: A total of 9 students admitted through the FPL program for training in the USA and in local institutions (Table 2).

[6] This section is to serve as a compilation of all program training activities and not meant to duplicate the Capacity Building section under individual Research Project Reports. It can be in chart format.

Table 2: List of higher degree students admitted under FPL program

Name	Gender	University	Degree	Major	Grad Date	Home Country	Institutional Home
Tim Tubbs	Male	Purdue University	MS	Plant Science	2016	USA	USA
Daniel Burgess	Male	Purdue University	MS	Plant Science	2016	USA	USA
Stacy McCoy	Female	Purdue University	PhD	Agricultural Economics	May-19	USA	USA
Pablo Cesar Torres-Aguilar	Male	Purdue University	PhD	Food Science	Aug-18	Ecuador	USA
Adeoluwa Adetunji	Male	University of Pretoria	PhD	Food Science	2016	Nigeria	South Africa
Nokuthula Vilakati	Female	University of Pretoria	PhD	Food Science	2017	South Africa	South Africa
Ayodeji Falade	Male	University of Pretoria	PhD	Food Science	2017	Nigeria	South Africa
John Gwamba	Male	University of Pretoria	MS	Food Science	Dec-2016	Botswana	South Africa

b) Institutional Development N/A
   i) Description
   ii) Partners

VIII) Technology Transfer and Scaling Partnerships N/A

a) Plan of Action
   i) Steps taken
   ii) Partnerships made
   iii) Technologies transferred
   iv) Technologies scaled
   v) Technologies ready to scale

IX) Governance and Management Entity Activity

The FPL Steering Committee (SC) meets once a month to discuss the strategic direction of the project and to review and approve potential funding initiatives. The SC also advise on the development, implementation, and monitoring & evaluation of the project, including strategic linkages and partnerships. The Advisory Council (AC) provides strategic guidance to the project and to support development of collaborative, efficient, effective science and management. The AC also helps FPL identify future trends and opportunities in post-harvest research and development. The first AC meeting was held on December 12, 2014.

X) Other Topics[7]

[7] Such as Regional Centers of Excellence, impact assessment, gender initiatives

XI) Issues[8]: There has been delay in implementing the program due to the following reasons:

a) Unanticipated changes in original collaborating institutions, including additions and removals due to various reasons.

b) Delayed signing of sub-agreements collaborators, mainly due to their limited experience in filing for US government required paper work.

Note:

- All approvals have now been obtained and all collaborators are expected to be on board for the year 2 funding cycle
- Project wide re-budgeting is currently underway to project activities carried over from year 1 funding cycle and year 2 activities.

XII) Future Directions: The FPL looks to be effective and relevant in the two focus countries of Kenya and Senegal through development of practical and cost-effective solutions for grain drying, storage, and processing in the humid topics. The solutions will be profitable for the manufacturers who make the technology; help create non-farm jobs; be profitable for the end users including farmers and processors and enable consumers to benefit from the nutritionally-enhanced grain-based products.

The FPL is also working to identify trends and opportunities for post-harvest grain research and engagement over the next 5 to 10 years, to expand the program and keep it relevant to the stakeholder needs.

[8] Such as financial, management, regulatory