

Food and Nutritional Evaluation Laboratory (FANEL): Growth Towards a Sustainable Service Unit



- Acquired and upgraded an Inductively Coupled Plasma Optical Emission Spectroscopy machine (ICP-OES) for mineral analysis, including an autosampler which enables high throughput analyses (Fig. 1).
- Research Associate Derick Malavi received training on operating the ICP-OES and X-Ray Fluorescence at the Maize Quality Laboratory, CIMMYT in Mexico.
- FANEL successfully registered for proficiency testing of our protocols with LGC Standards, an accredited proficiency testing laboratory based in the UK.
- Implemented the FANEL business plan to ensure sustainability as a service unit.
- Improved the functionality of FANEL-FLOW, an on-line system available via a web browser, to help improve workflow management within the FANEL.



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Fig 1. Research Associate Derick Malavi explains how the ICP equipment works (Credit S. Nyanchera)

What was the problem?

In sub-Saharan Africa (SSA), the lack of modern and high throughput analytical tools coupled with limited capability to conduct comprehensive nutritional analyses, food chemistry, food safety and product development studies delays progress in many projects. Outsourcing these analytical services is a time-consuming exercise that is associated with high cost per sample. Additionally, for fresh samples which require analysis soon after harvest, packaging them and sending them outside the country for analysis may affect their integrity, potentially leading to erroneous conclusions. For the International Potato Center (CIP), these issues hindered timely progress critical to the development of processed products using orange-fleshed sweetpotato (OFSP) as an ingredient for nutritional improvement in SSA and the evaluation of promising clones in its high iron orange-fleshed sweetpotato breeding program.

What do we want to achieve?

Since the establishment of FANEL in 2014 at the Biosciences for east and central Africa (BecA) facility, on the International Livestock Research Institute (ILRI) campus in Nairobi, Kenya, FANEL has been jointly run by ILRI-BecA and CIP. Our main objective is to strengthen the food and nutritional evaluation capacity within SSA, by having an excellent reference laboratory equipped with advanced analytical tools and operated by knowledgeable staff. FANEL in turn, will be available for use by other research and will train and support other laboratories. Building on existing capacity for mycology research, capacity has been gradually expanded to include nutritional evaluation, food compositional analysis, food product development, food safety analysis and post-harvest research. Standard operating procedures,

validated by international organizations and working according to international standards, have been adopted. The nutritional research laboratory needs to operate efficiently and cost-effectively. The laboratory has a strong capacity building component, bringing in scientists from National Agricultural Research Systems (NARS) and graduate students from local and regional universities in partnership with the ILRI-BecA Hub or CIP.

Where and with whom are we working?

FANEL is housed and hosted within the Nutrition and Food Safety Platform, ILRI-BecA. BecA is an essential partner for FANEL which financially supports the research activities of hosted students and NARS visiting fellows through the BecA Africa Biosciences Challenge Fund (ABCF) fellowship. CIP, through FANEL, collaborates with local, regional and international universities such as University of Nairobi (Food Science and Nutrition department), Pan African University (PAU), Jomo Kenya University of Agriculture and Technology (JKUAT), Greenwich University's Natural Resources Institute in the UK, James Hutton Institute (UK), North Carolina State University, South Dakota State University (SDSU) and Tufts University in the USA. FANEL is also working collaboratively with other CGIAR centers and the French Agricultural Research Centre for International Development (CIRAD) and the CGIAR research program on Roots, Tubers and Bananas (RTB). In addition, FANEL engages private sector and NGO partners on collaborative projects in processing and product development of OFSP in SSA.

How are we making it happen?

Capacity building is a crucial determining factor to the success of FANEL. FANEL is an innovation platform where

motivated students and senior researchers converge and explore their ideas in food science, nutrition, technology and post-harvest management.

What have we achieved so far?

The first priority of FANEL was to establish carotenoid analysis capacity using High-Performance Liquid Chromatography (HPLC). Since July 2016, FANEL has analyzed 5,110 samples for beta-carotene content. Between 2015-2018, capacity for proximate analysis, and vitamin C analysis was added. In 2018, the acquiring of the ICP enabled analysis of mineral samples, particularly critical for breeding for high iron and high zinc OFSP, because the ICP provides information on other minerals that may indicate that the iron content has been influenced by soil contamination.

From 1-18 February 2019, Derick Malavi, a FANEL Research Associate, attended a hands-on training on mineral analysis using ICP-OES in Maize Quality Laboratory, CIMMYT in Mexico. New methods have since been developed in FANEL enabling quantification of minerals in different food samples from our partners and other clients. The ICP-OES was upgraded to include an autosampler which enables high-throughput analyses of up to 100 samples within a short period of time. This has greatly improved our capacity to quantify the mineral composition of different samples (Fig. 1).

In 2018, Luka Wanjohi, the SASHA data manager helped FANEL scientists develop FANEL-FLOW, an on-line system available via a web browser, to help improve information and workflow management within the FANEL (Fig. 2). In 2019, functionalities that were improved include the ability to select multiple analyses for the same sample and generation of reports indicating number of analyses done within a particular time frame. 1,810 analyses have been done between January and June 2019. New tabs for exporting files indicating the progress of sample analysis have been added in the system. We are working on enhancing the system by creating features for generating financial reports and bulk printing of labels.

FANEL successfully registered for proficiency testing of our protocols with LGC Standards, an accredited proficiency testing laboratory based in the UK. The test samples were received and the entire FANEL team participated in carrying out the analyses. The protocols which were reviewed are those for vitamin C, carotenoids, minerals, crude fibre, moisture, fats, total sugars, proteins and ash. Results were uploaded on time on the LGC portal and we are currently waiting for the results.

FANEL has played a critical role in the development of a safe OFSP purée that is shelf-stable for 3 months without

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Fig 2. Lucy Mwaura, a Senior Research Associate, demonstrates to Mariam Nakitto how the FANEL-Flow system works (Credit S. Nyanchera)

refrigeration. FANEL researchers have backstopped private companies in food safety and nutritional composition analysis for products using OFSP purée as a key ingredient. Recently, support is being provided on food safety and quality management to Burton & Bamber Ltd. This company will be processing purée to cater for the Eastern and Central Kenya supply of puree for production of OFSP-based processed products.

In 2018, FANEL developed a comprehensive business plan to become a sustainable service unit serving research on food quality. As part of the exercise, the cost of running each analysis offered by FANEL was determined (Table 1). This information helps researchers' budget appropriately for different tests.

What's next?

The full implementation of the food safety laboratory, starting with a food safety workshop which is scheduled for December 2019. We are currently awaiting the results of the proficiency testing for our analytical protocols through LGC Standards, UK. We also expect to have completed the accreditation of the FANEL laboratory by the end of 2019.

Table 1. Average cost of types of analysis offered by FANEL 2019

Analysis	Cost per sample (USD)
Carotenoids (Fresh roots & tubers)	37.13
Carotenoids (Baked products)	29.51
Carotenoids (RTB powdered products)	27.94
Vitamin C	9.96
Total anthocyanins	7.14
Crude fat	8.71
Crude Protein	6.47
Total starch	9.02
Total sugars	7.23
Individual sugars	11.25
Glycoalkaloids	52.72
Moisture Content	7.42
Water activity	11.85
Colour	9.88
Crude fibre	7.42
Ash	7.42
PH	9.28

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