Food Matrices and Nutritional Bioavailability Roundtable

Improving the Nutritional Value of Foods in the Food Aid Basket: Optimization of Macro and Micro Nutrients, Food Matrices, Novel Ingredients and Food Processing Technologies

Sunday, June 25, 2017, 8:30am-3:30pm

Venue: Sands Expo, Las Vegas

Organized by: Tufts University Food Aid Quality Review;
www.foodaidquality.org

Sponsored by: USAID's Office of Food for Peace

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Challenges to improve nutritional value of food aid products – Using animal proteins

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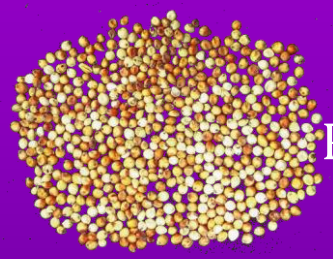
USDA Foreign Agricultural Service
Micronutrient Fortified Food Aid Products Pilot (MFFAPP) 2012-16

Novel Sorghum-Based Fortified Blended Foods for Infants and Young Children



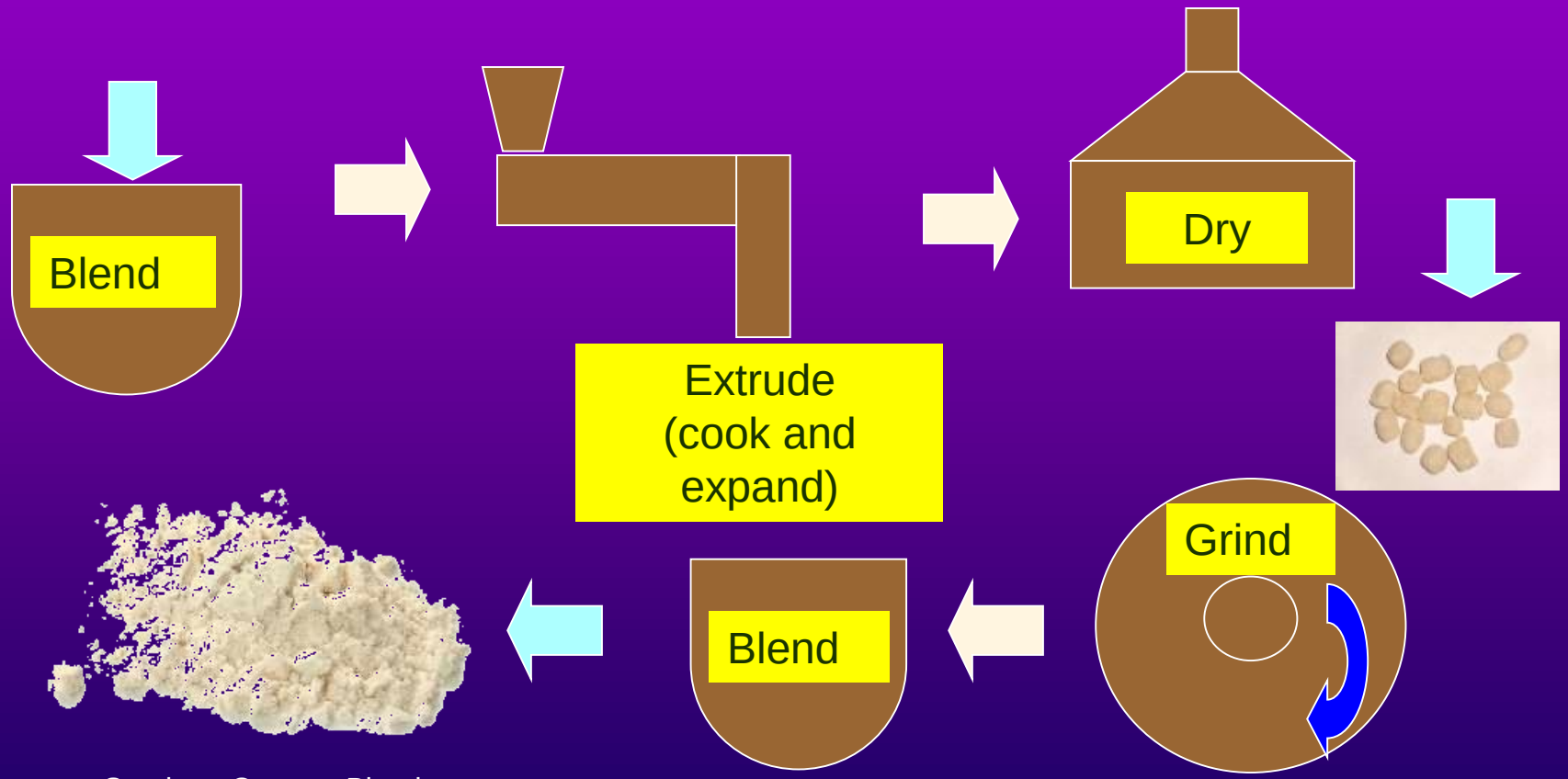
Budget: $5,000,000

PIs: Drs. Sajid Alavi , Nina Lilja, Edgar Chambers, Brian Lindshield and Sandy Procter

The overall goal of the study is to develop novel, extruded, high-protein, sorghum-based micronutrient fortified blended foods that can be used for nutritional aid programs in Tanzania. These products will be pre-cooked sorghum-soybean and sorghum-cowpea blends or 'porridge mixes' that can be used for supplemental feeding and nutrition programs for infants and children below the age of 5 years. These blends require much lower energy/fuel to prepare into gruels compared to fortified blended foods currently used in feeding programs. In addition, these products enhance the use of U.S. sorghum, soybeans and cowpea for value-added food applications. This can lead to greater demand for these drought-tolerant crops in Africa and reduce the current dependence on corn that is a cause of food insecurity in cereal deficient countries. Research and development on non-GMO food aid commodities, such as sorghum and cowpea also is important because several food aid recipient countries have strict regulations relating to the imports of GMO products.

Sorghum Based Fortified Blended Foods

Sorghum (39-75%)
Soy flour or cowpea flour (25-61%)



Sorghum-Based Fortified Blended Foods

KSU Fortified Blended Foods Team

Dr. Edgar Chambers IV
Sensory Analysis

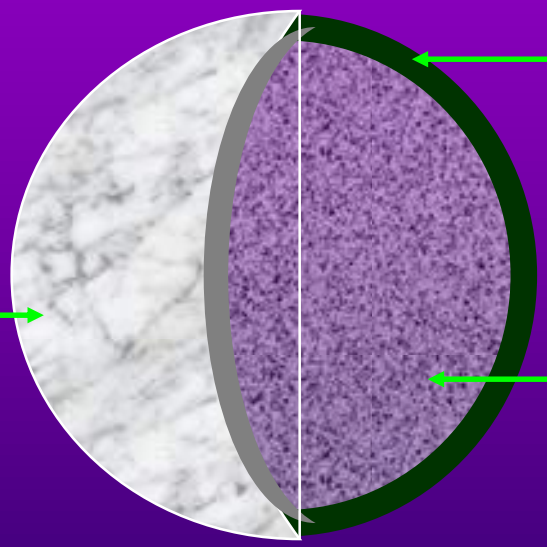
Dr. Brian Lindshield
Nutrition

Dr. Sandy Procter
Maternal and Infant Health

Dr. Sajid Alavi
Process Engineering

Dr. Nina Lilja
Agricultural Economics

Sorghum proteins



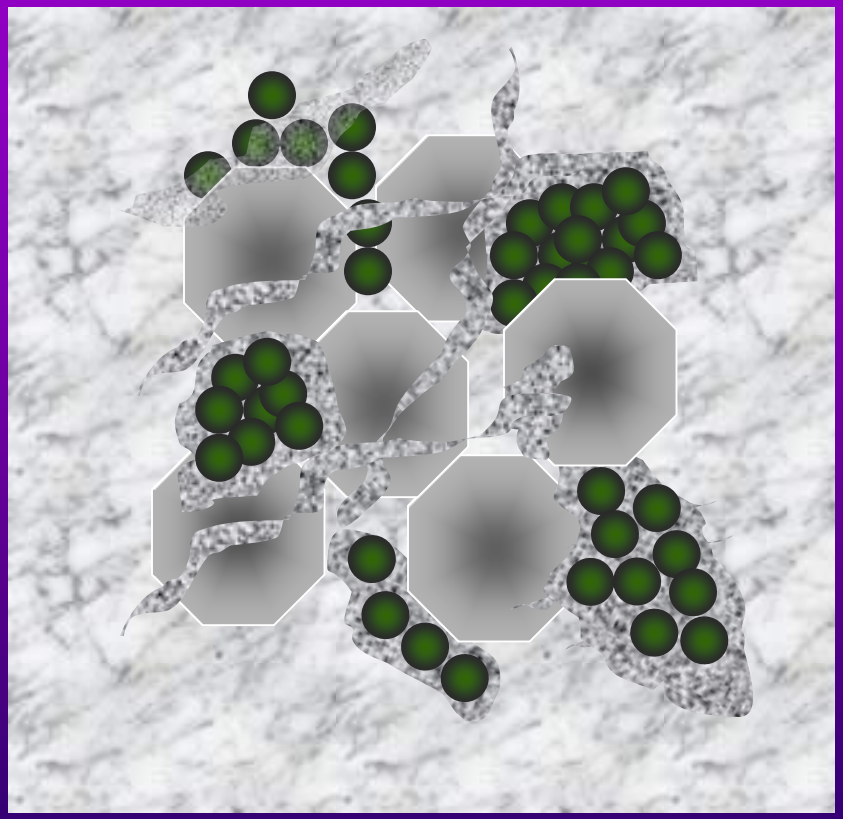
Outer "shell" composed mainly of crosslinked β- and γ- kafirins

Interspersed glutelin matrix material coating the protein body

Interior composed mainly of α-kafirin

Schematic representation of 'protein bodies' in sorghum endosperm

Protein bodies and starch granules are embedded in the glutelin matrix.

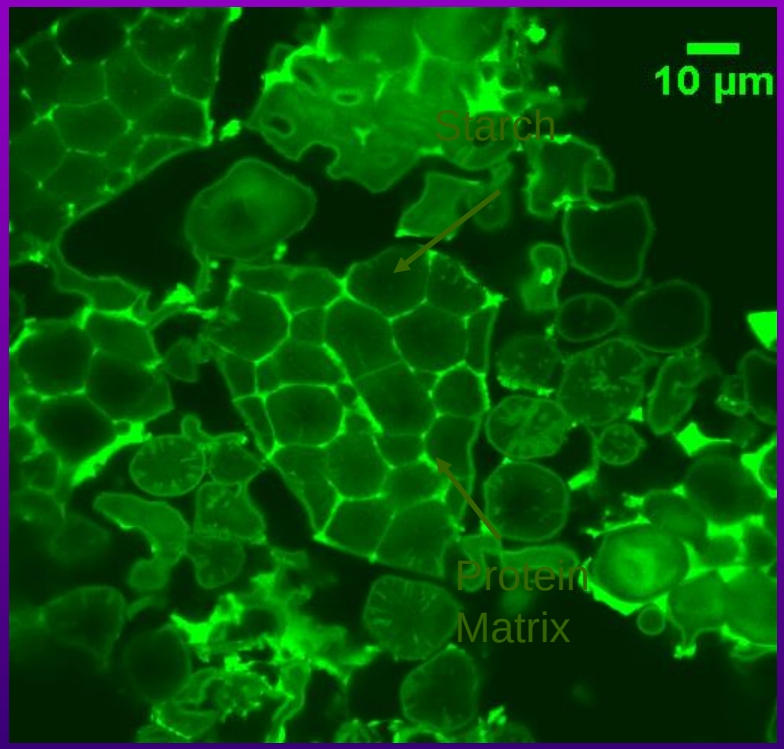


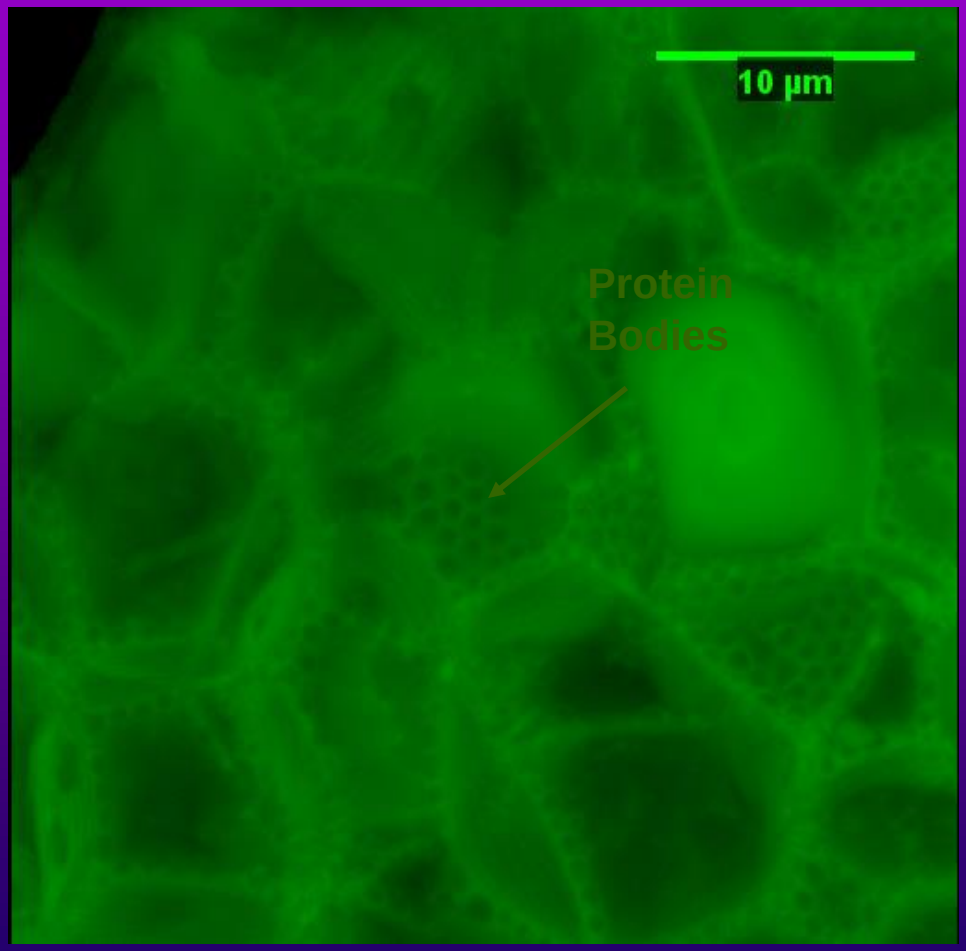
Protein bodies

Starch granule

Glutelin protein matrix

Raw Sorghum Flour





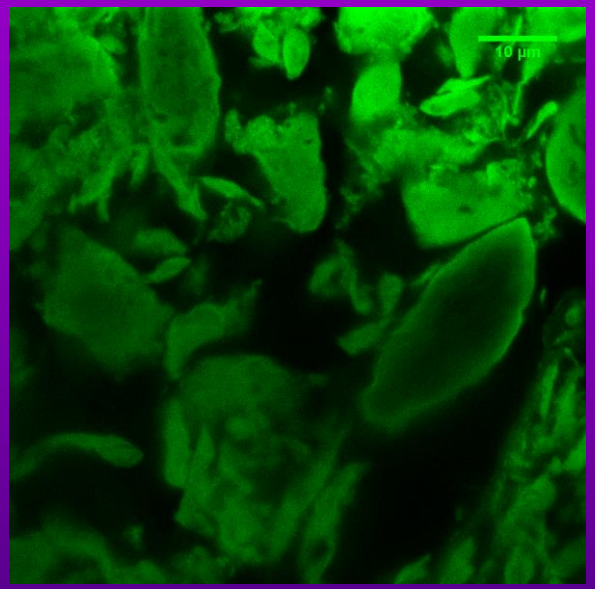
Sorghum Protein Digestibility

- Raw, condensed tannin-free, white sorghum:
  - 55.8 % (raw, whole grain)
  - 67.4 % (raw, decorticated)
  - 36.6 % (boiled, whole grain)
  - 39.4 % (boiled, decorticated)

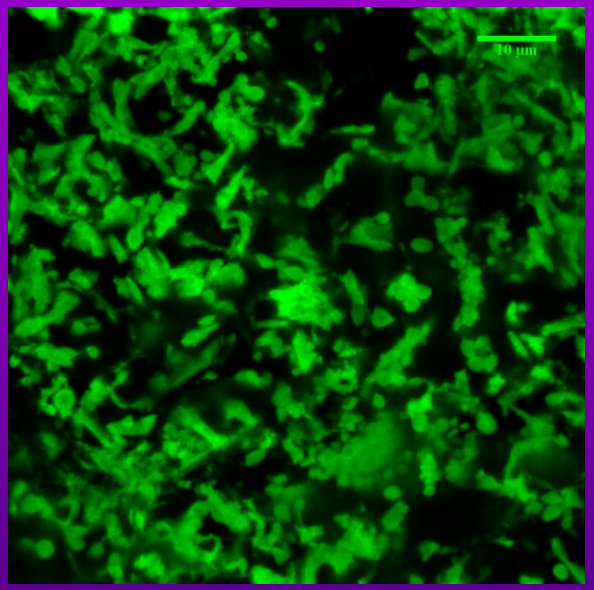
(Duodu, 2002)

Wet cooking reduces protein digestibility.

Sorghum Protein After ‘Dry’ Extrusion Cooking

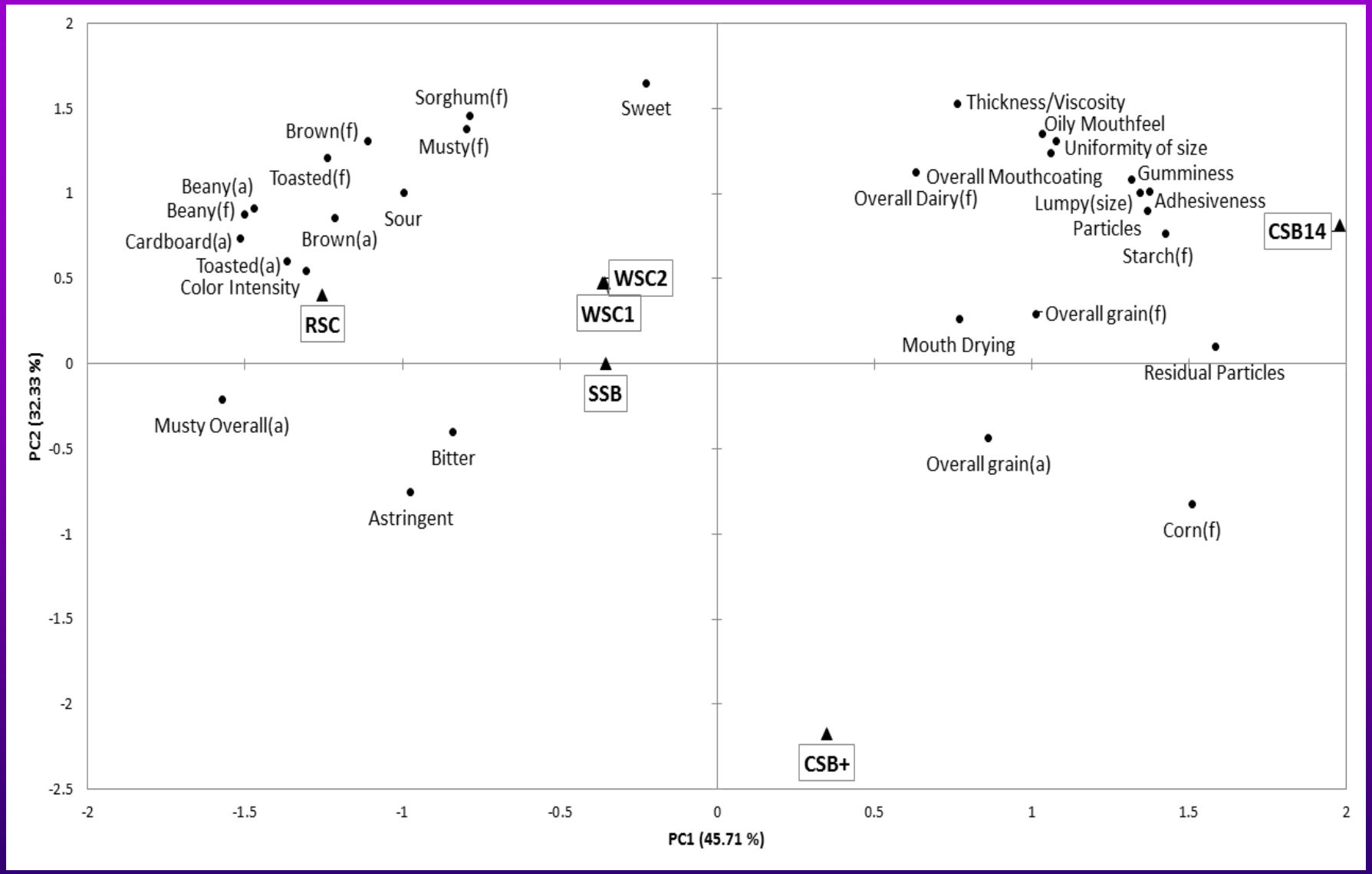


38 % digestibility



66 % digestibility

Confocal Laser Scanning Microscopy (CLSM) is a useful tool in explaining the structural changes after cooking leading to differences in digestibility.



Principal component analysis representing sensory characteristics for porridge prepared from 6 fortified blended foods.

Field Trial Description

Twenty-week, partially randomized cluster control trial located in the Mara region of Tanzania between February and July 2016. White sorghum cowpea (WSC-1, WSC-2), red sorghum-cowpea (RSC), white sorghum-soy (WSS), extruded corn-soy blend (CSB14), or currently used fortified blended food CSB+ as control were provided to 2186 children divided into two age groups (6-23 and 24-53 months) in seven clusters. A negative control received no FBF until study end.

Field Trial Data Collection

At 0, 10, and 20 weeks, health questionnaires, hemoglobin, vitamin A (DBS), and anthropometric measurements (height, weight, MUAC or mid arm upper circumference, WAZ or weight-to-age z-score, HAZ or height-to-age z-score and WHZ or weight-to-height z-score) were monitored for each cluster at each time point. Differences in baseline socioeconomic factors, food intake and unadjusted outcomes were analyzed with SAS statistical software. Absolute anemia and vitamin A deficiency risk reduction was calculated for all FBFs and control compared to CSB+.

Field Trial Results

84.4% and 86.7% of 6-23 months and 24-53 months completed the study. The lowest completion rate was the in the CSB+ groups although there were no significant differences in dropout rates between clusters ($p = 0.07$).

Field Trial Results

- Most sorghum based FBFs significantly reduced 6-23 month old anemia risk. CSB+ did not.
- All sorghum based FBFs significantly reduced 6-23 month old vitamin A deficiency risk. Similarly formulated and extruded CSB14 did not.
- Anthropometric outcomes were similar between sorghum and corn FBFs.

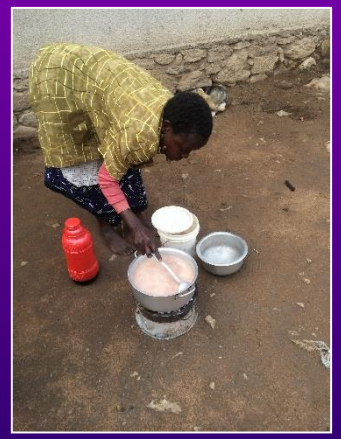
Collectively these results suggest that newly formulated, extruded sorghum FBFs have at least equal, and potentially superior, nutrition efficacy to corn FBFs.

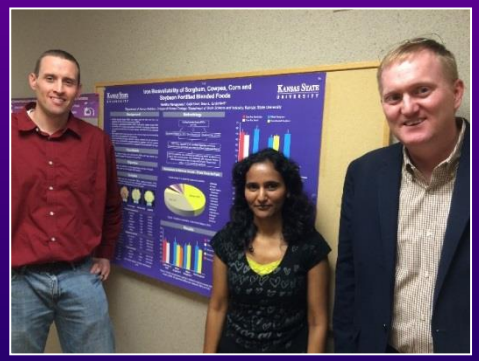
Processing Challenges in Industry

- Mills are designed to meet the needs of their customer base such as cereal, brewing, snack food, baking and breading manufacturers as well as some industrial applications. The addition of animal proteins creates an additional allergen source…
- Demand, price expectations, and longevity of the product are not clearly communicated or understood…
- Quality issues with products such as CSB (example, Bostwick, shelf life, etc)
- ‘Co-extrusion’ versus separate processing of corn and soy in CSB manufacture

Thanks!

KSU Fortified Blended Foods Team





Sorghum Based Fortified Blended Foods – A K-State Global Food Systems Initiative

https://www.youtube.com/watch?v=e2xj1V7od8s&feature=youtu.be