2022 ANNUAL REVIEW MEETING

March 21-25, 2022

Virtual
Advancing improved functionality and protein quality sorghum hybrids for food applications in Ethiopia

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Phase II goal & objectives

- Goal to improve sorghum competitiveness and value as food ingredient in Ethiopia
  - Advancing opportunities for new HPD sorghums

- Research objectives
  - Commercially viable sorghum processing technologies for local food applications (injera, cookies, pancakes, kinch, popped/boiled sorghum)

- Improved HPD sorghum hybrid seed production in Ethiopia
- Functional basis of HPD sorghum
Key Project Objectives (Simplified)

- Commercially viable sorghum processing technologies for local food applications
- Improved HPD sorghum hybrid seed production in Ethiopia
- Functional basis of HPD sorghum
Accomplishments
Key Activities, challenges & Achievements

- **Obj. 1:** Commercially viable sorghum processing technologies for local food applications
  - Injera recipe for waxy and HD normal is documented from previous works (SMIL I) and some refinements (sensory) are underway.
  - Cookies recipe from HD with normal starch are documented
    - adopted to Ethiopian sensory preferences – spices addition
  - Pancakes from HD normal sorghum will also be tailored to Ethiopian market
  - Sorghum quality analysis and Milling at TAMU is complete – milling trials still under way in Ethiopia – selection of technologies and also using flour for kinche and more
Trials from SMIL phase I
 ✓ Obj. 1: . . .

- Organization of working lab space at HwU

- Grain analysis and small-scale malting trial started
Key Activities, challenges & Achievements . . . Cont’d
Key Activities, challenges & Achievements . . . Cont’d

✓ Obj. 1: . . .

- Identified Milling types for trial processing of sorghum
- Milling facilities specified and identified (mill, oven, tools, consumables, etc.)
- Local sorghum varieties with potential for adjunct in brewery and injera making are identified
• A Argity,
• B Debir,
• C ESH-1,
• D ESH-4,
• E Macia,
• F Gambella-110,
• G Meko,
• H Melkam,
• I Red-Swazi,
• J Teshale and
• K Tilahun,

G = Germ,
FE = Floury Endosperm &
CE = Corneous endosperm.

**Figure:** Endosperm texture of the sorghum varieties
Red Swazi, Meko and Debir had higher (p<0.05) rate of water absorption compared to other varieties.
Obj. 1: . . .

- Melkam (45.53) and ESH-1 (47.37) had hot water extract greater than commercial sorghum malt (36.2%, Mezgebe et al., 2018).

- All of the sorghum varieties showed lower HWE than the Desired barley malt quality for brewing (>81%), although comparing sorghum to malt is not fair.
Obj. 1: . . .

ESH-1 and Melkam exhibited greater endosperm modification on malting. With higher enzymatic activity than minimum DP specification for sorghum malt by a sorghum brewery, higher cold and hot water extracts (CWE, HWE).
Key Activities, challenges & Achievements . . . Cont’d

Local sorghum: GE testing in Hawassa
A: Debar
B: Gambella
C: Zengada1
D: Zengada2
E: Zengada3
Key Activities, challenges & Achievements . . . Cont’d

Steep-out

Germinated (72h)
Key Activities, challenges & Achievements . . . Cont’d

- Obj. 2: Improved HPD sorghum hybrid seed production in Ethiopia

  (EIAR) Melkassa is working on getting the TAMU HPD lines into the Ethiopian seeds systems, although conflict affected many of the centers where trial were underway

- Dr. A. Tirfesa may give details of the progress (discussion, presentation)
Effect of HD trait on starch retrogradation kinetics

HD Sorghum Pancake RVA - Fresh (0 h) vs 24 h

LD sorghum Pancake RVA - Fresh (0 h) vs 24 h
Cysteine residues in HD vs wild type sorghum

Nmol –SH/ mg protein

- HWx/HD
- N/HD
- N/LD

Wild type

HD trait

**Cysteine residues in HD vs wild type sorghum**
Free thiol groups in HD vs wild type sorghum as affected by cooking and oxidation

- **HD Trait**
  - HWx/HD: a (bc)
  - N/HD: ab (c)

- **Wild Type**
  - N/LD: b (c)  
  
- **40mM KBrO3**
  - Raw
  - Cooked

<table>
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<tr>
<th>Trait</th>
<th>Raw</th>
<th>Cooked</th>
<th>40mM KBrO3</th>
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<td>HWx/HD</td>
<td>12</td>
<td>8</td>
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<tr>
<td>N/LD</td>
<td>8</td>
<td>4</td>
<td>b</td>
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</tbody>
</table>
Effect of HD trait on gel hardness over time (starch retrogradation)

Maize starch + sorghum protein

Sorghum endosperm

- Control - HD
- Control - Wild type
- Reduced - HD
- Reduced - Wild type
Lessons

- Macia and Melkam are suitable for adjuncts with higher HWE.
- ESH-1 and Melkam could be considered for malting with comparable desirability to that of waxy and HD lines.
The production side is still slow due to the ongoing conflict
Future works

- **Obj. 1:**
  - Lab and Micro-level brewing Testing and Demonstration
  - Pilot milling trials in Ethiopia (disc & pin mills) using experimental hybrids in comparison to local sorghum lines
  - Roller milling at TAMU is complete
  - R&D with the local varieties will continue in the Technology finetuning dimension
  - Strengthened facilities for bakery and sensory laboratories
Future works . . . Cont’d

- Obj. 1: . . .
- Identify post-doc training opportunities for Drs. Tadesse and Abadi as part of the HwU human capacity development plans
- Demonstration of appropriate sorghum milling technology and utilization of sorghum as alternative adjunct in local brewing
Future works . . . Cont’d

- **Obj. 2:** Initiating field testing of locally dev’d hybrid seeds in Ethiopia

- Continuing hybrid seed production work at TAMU

- Seed production system for the HPD lines in Ethiopia for further development based on both food quality and field performance traits
The main Challenges as we move forward are:

- Making large quantities of sorghum available for the current pilot food products at bakeries and breweries, and associated cost of improved sorghum in bulk production vs. variability of quality.

- Delay in some project activities due to conflict, pandemic and locust infestation in sorghum belts

- Gaps on full scale future commercialization of improved sorghum (Novel sorghum for industrial utilization) products in Ethiopian food system
Thank you!

Acknowledgement

This study is made possible through funding by the Feed the Future Innovation Lab for Collaborative Research on Sorghum and Millet through grants from American People provided to the United States Agency for International Development (USAID) under cooperative agreement number AID-OAA-A-13-00047. The contents are the sole responsibility of the authors and do not necessarily reflect the views of USAID or the US Government.
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