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Collaborative Research
on Sorghum and Millet

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Collaborative Research
on Sorghum and Millet

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



Key Activities, challenges & Achievements . . . Cont'd

- ✓ **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

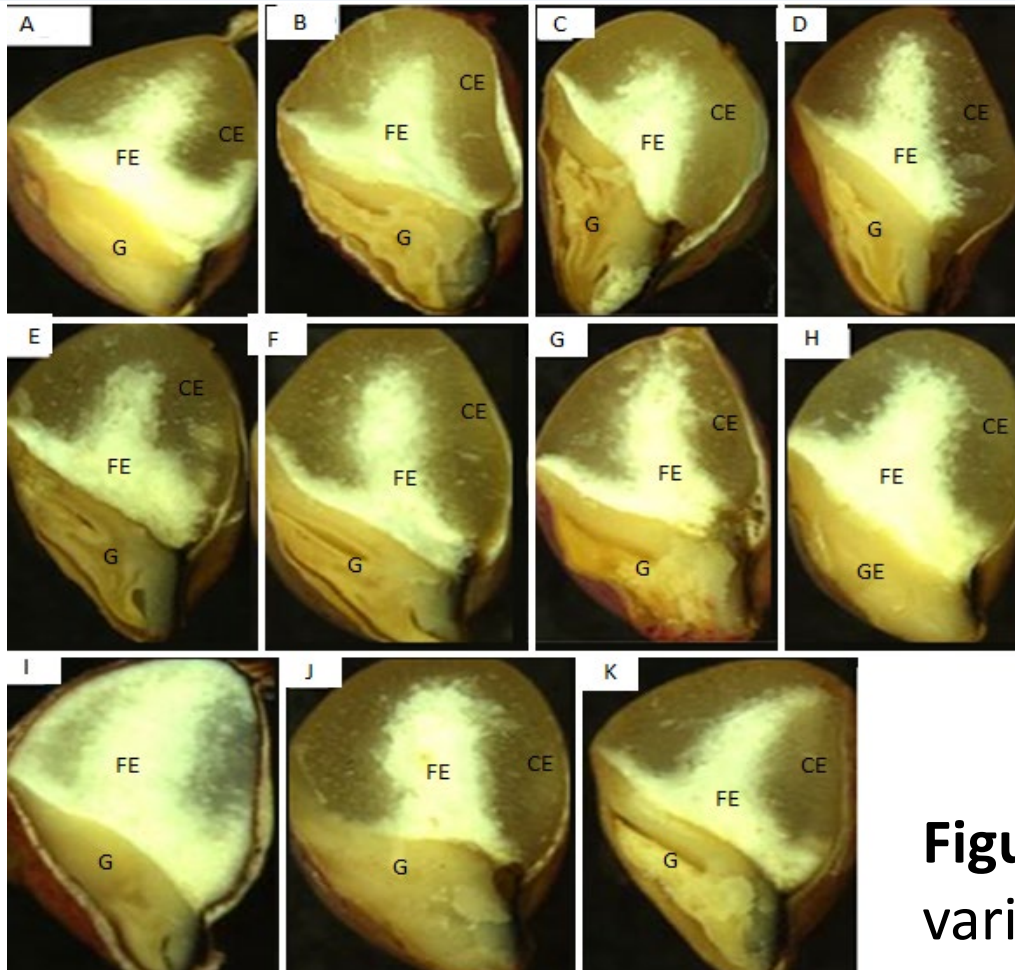
✓ Obj. 1: . . .

- 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



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- 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

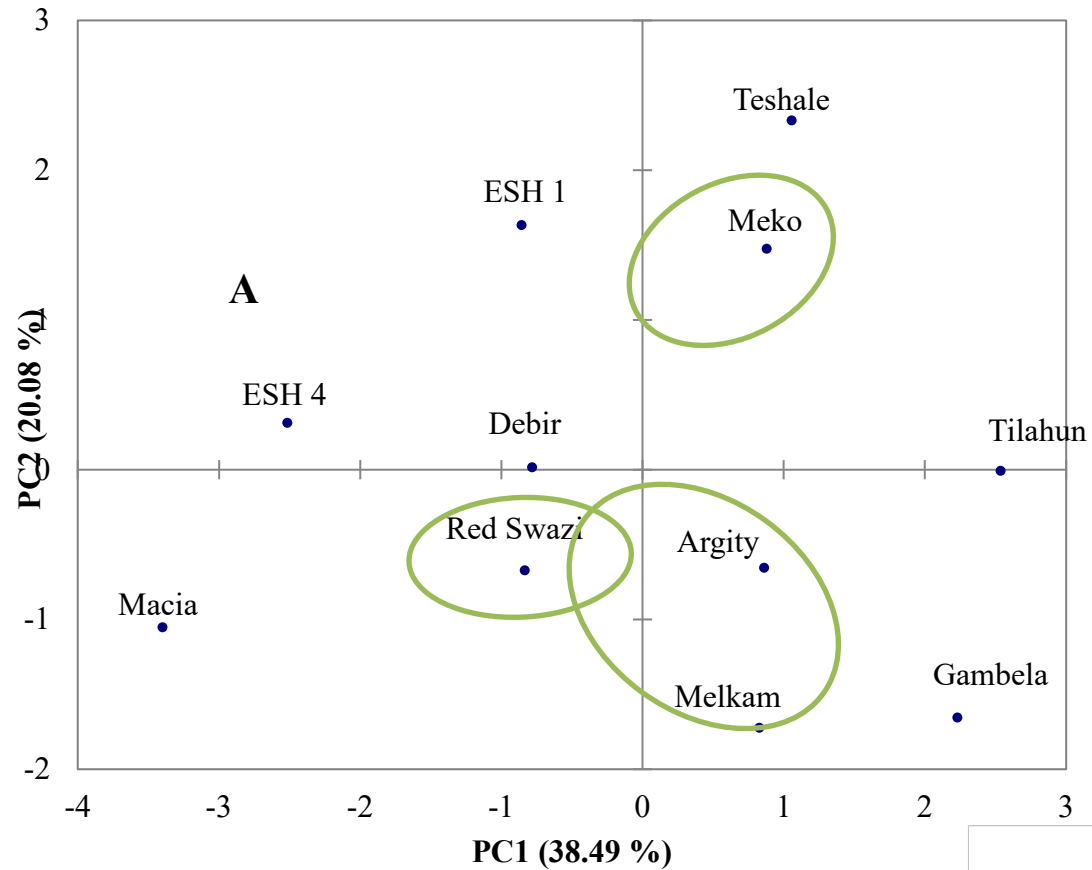


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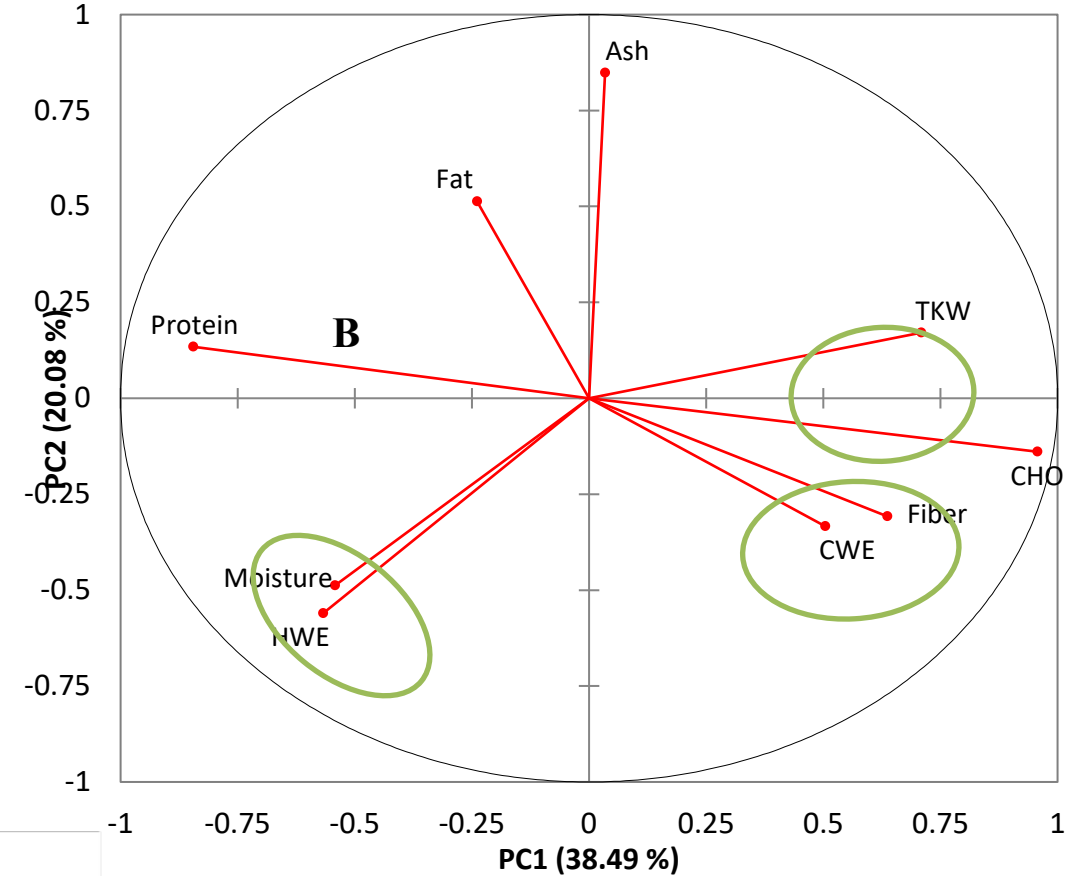


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Observations (axes PC1 and PC2: 58.57 %)



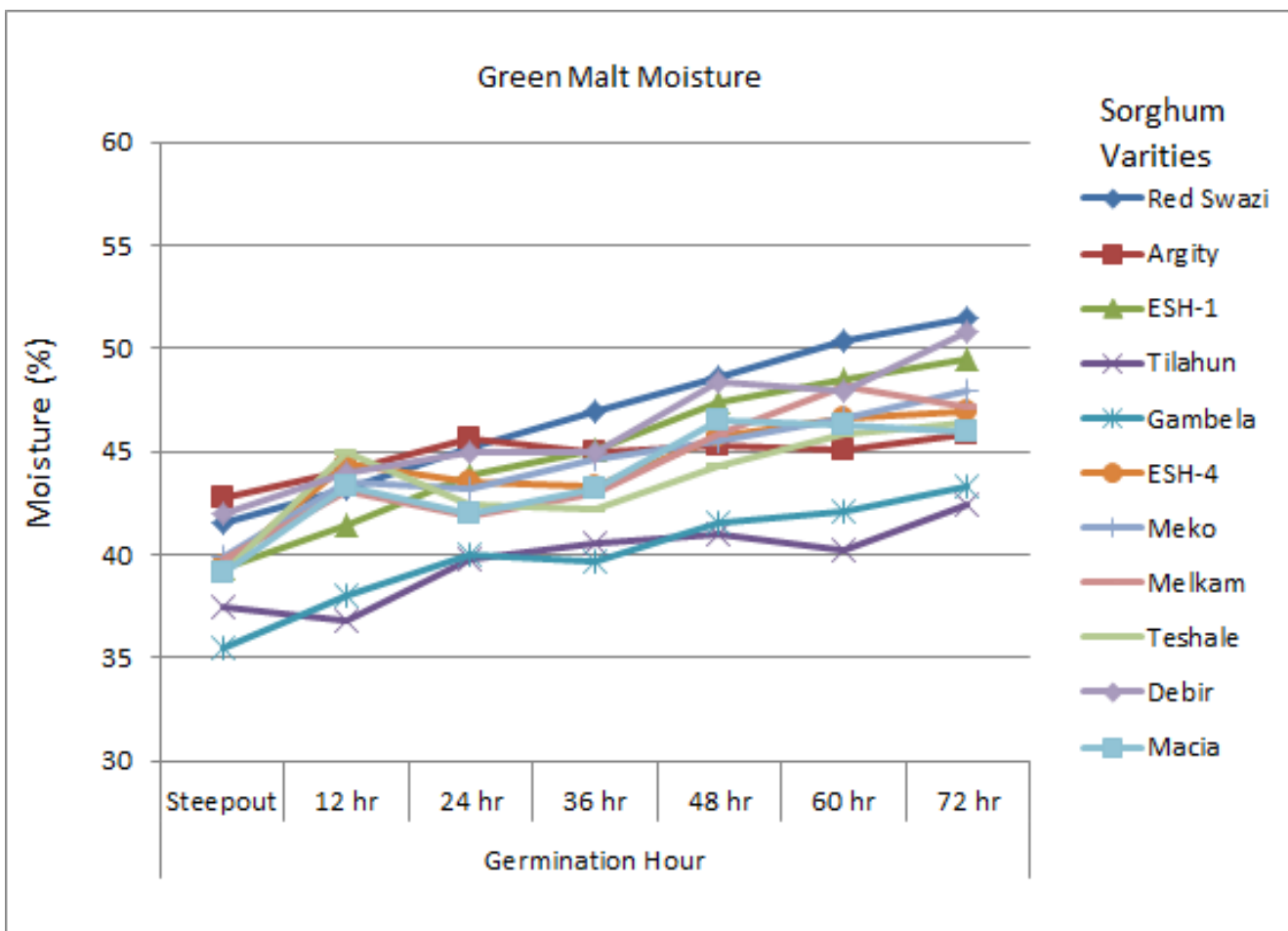
Variables (axes PC1 and PC2: 58.57 %)





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❖ Red Swazi, Meko and Debir had higher ($p < 0.05$) rate of water absorption compared to other varieties



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Key Activities, challenges & Achievements . . . Cont'd

✓ 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.

Key Activities, challenges & Achievements . . . Cont'd

✓ **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).



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fermented glossiness sponginess
rollability flexibility
elastic
eye evenness grain
grittiness eye size injera smell
stale
dry mouthfeel bottom surface
sourness-1 sticky soft-1 breakability-2
sweetness softness-2 dry surface
breakable
chewiness sourness-2



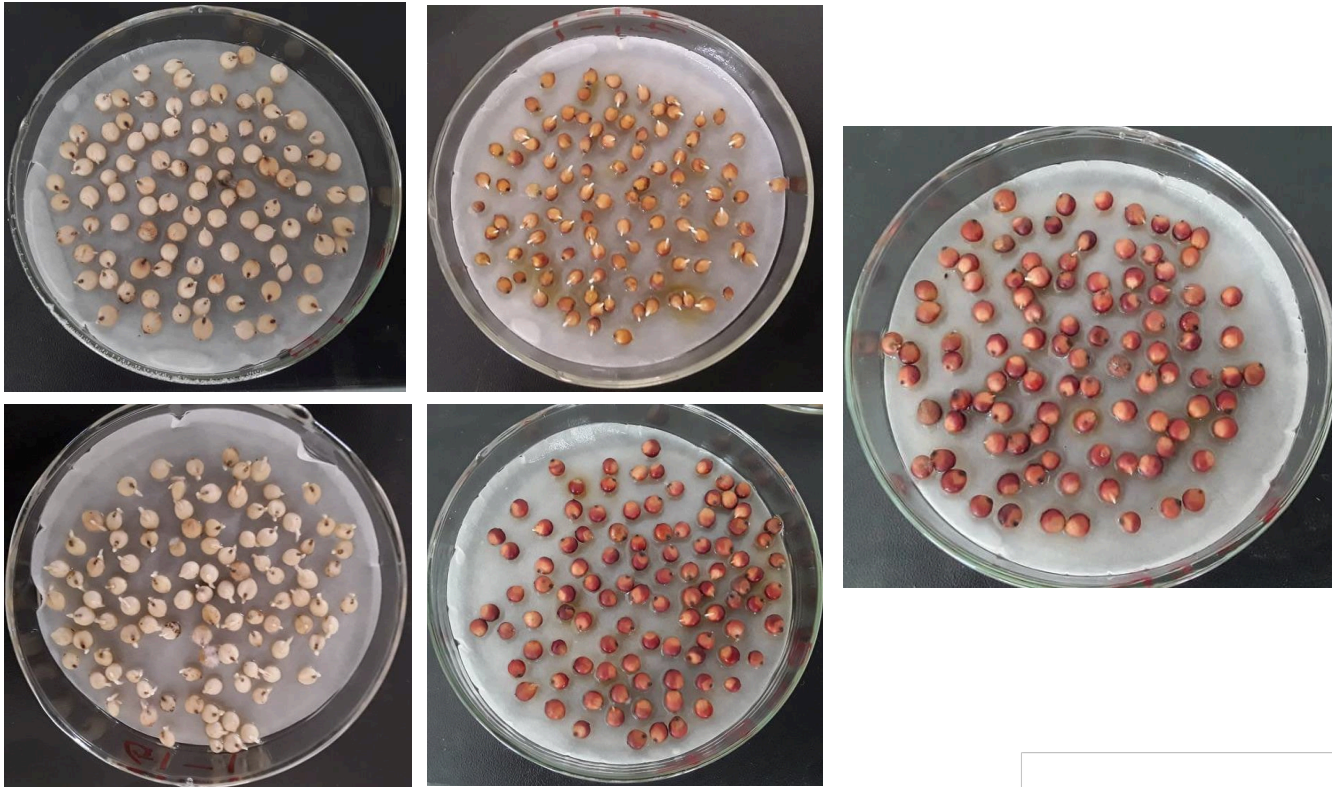
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Key Activities, challenges & Achievements . . . Cont'd



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)

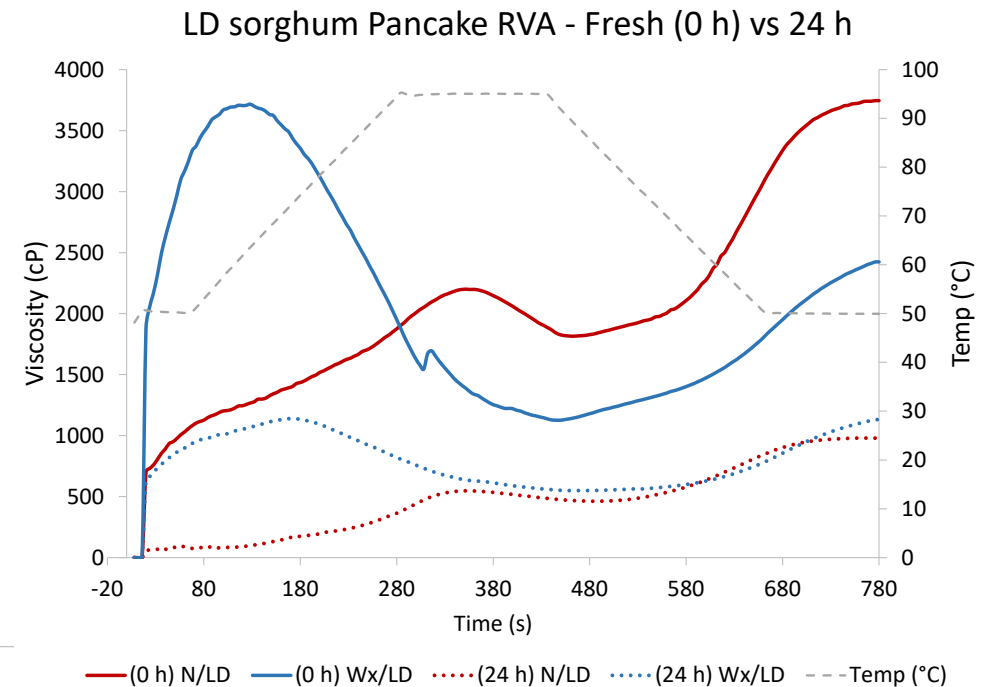
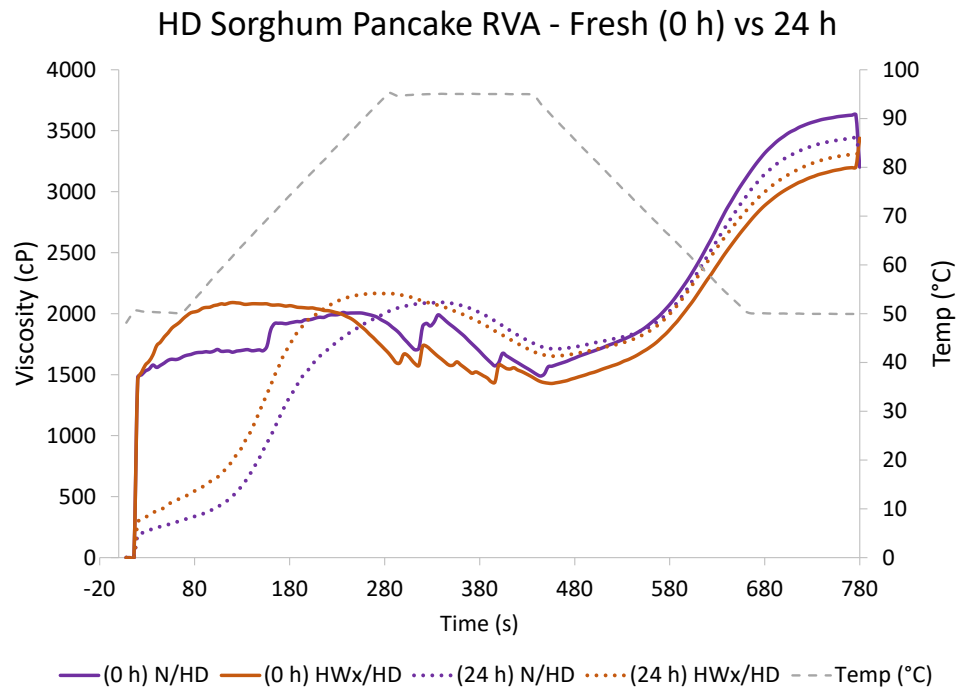


Key Activities, challenges & Achievements . . . Cont'd

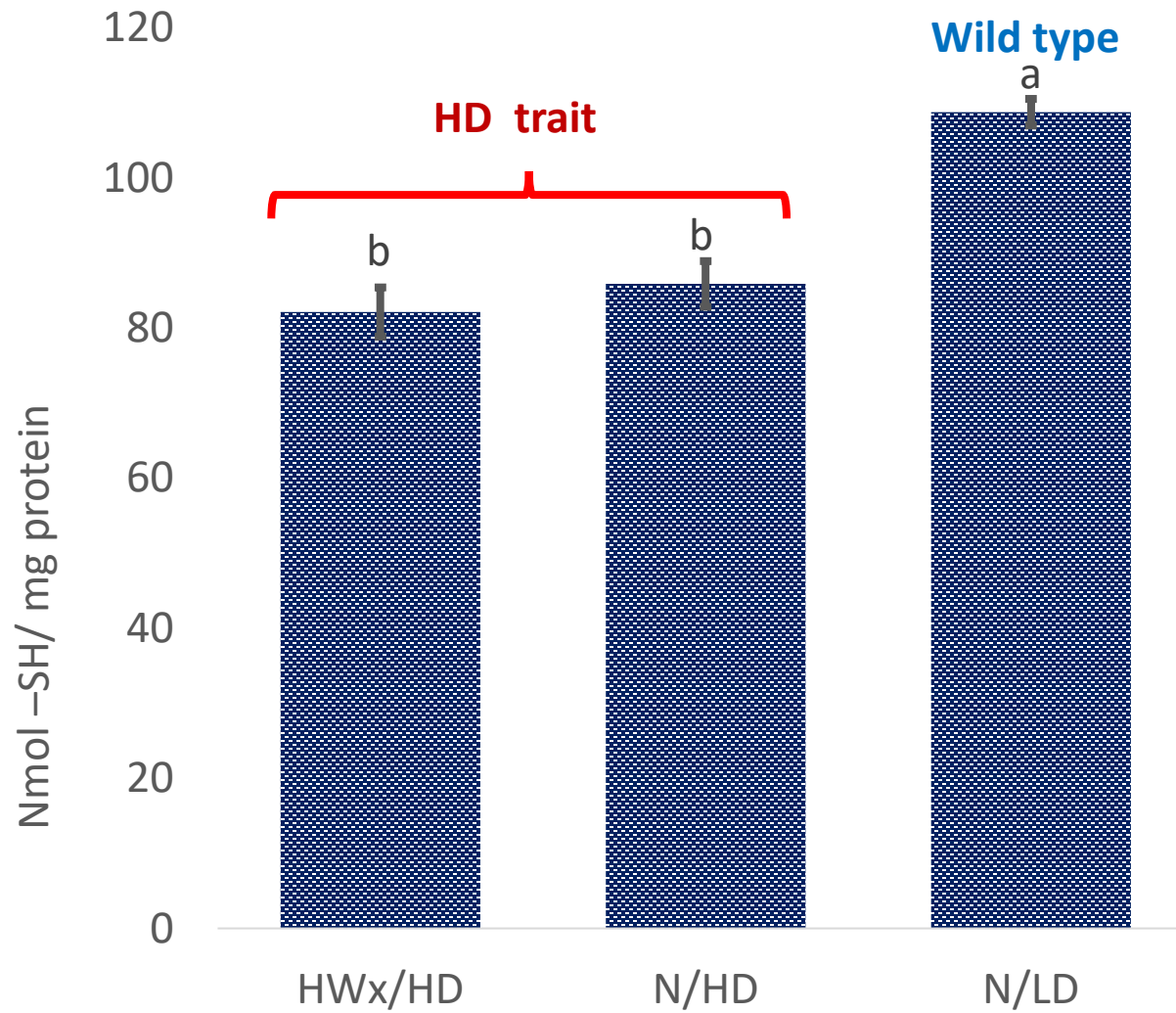
- **Obj. 2: . Improved HPD sorghum hybrid seed production in Ethiopia**
- (EIAR) Melkassa is working on getting the TAMU HPD lines into the Ethiopian seeds systems, although conflict affected many of the centers where trial were underway
- Dr. A. Tirfesa may give details of the progress (discussion, presentation)

Key Activities, challenges & Achievements . . . Cont'd

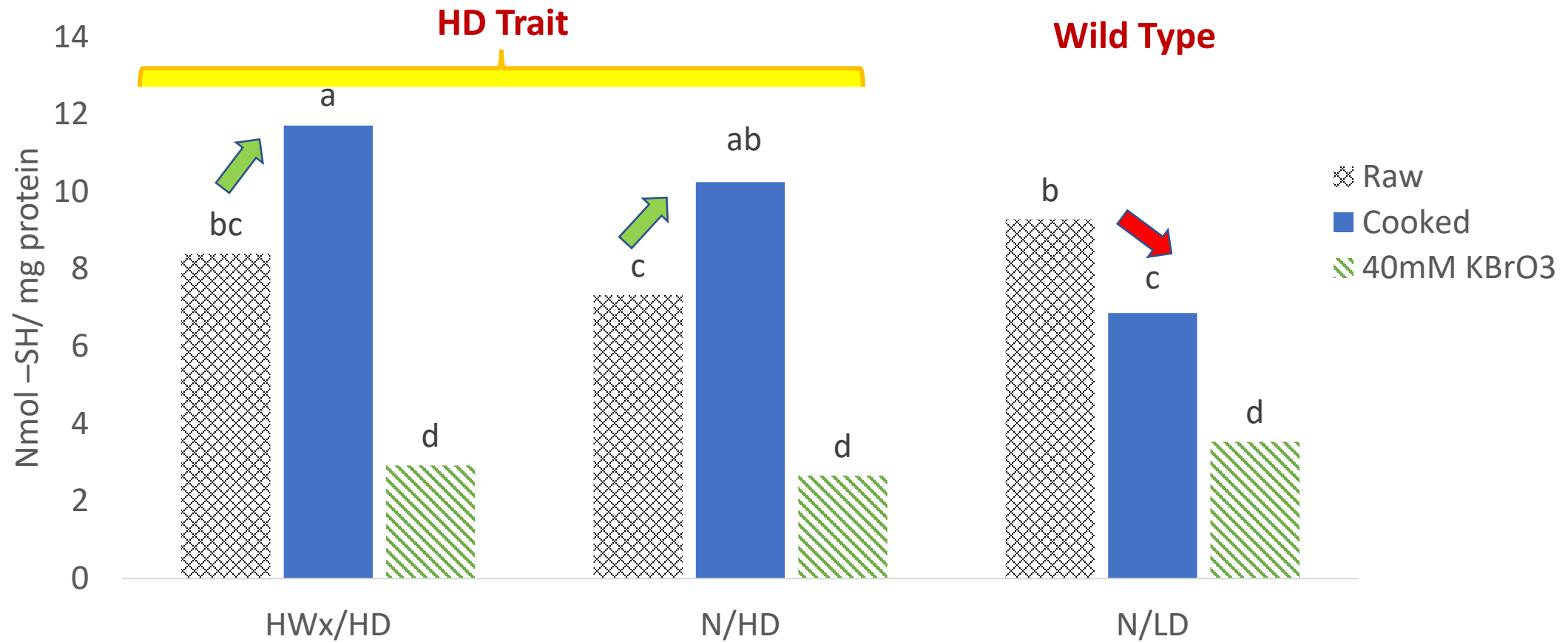
Effect of HD trait on starch retrogradation kinetics



Cysteine residues in HD vs wild type sorghum

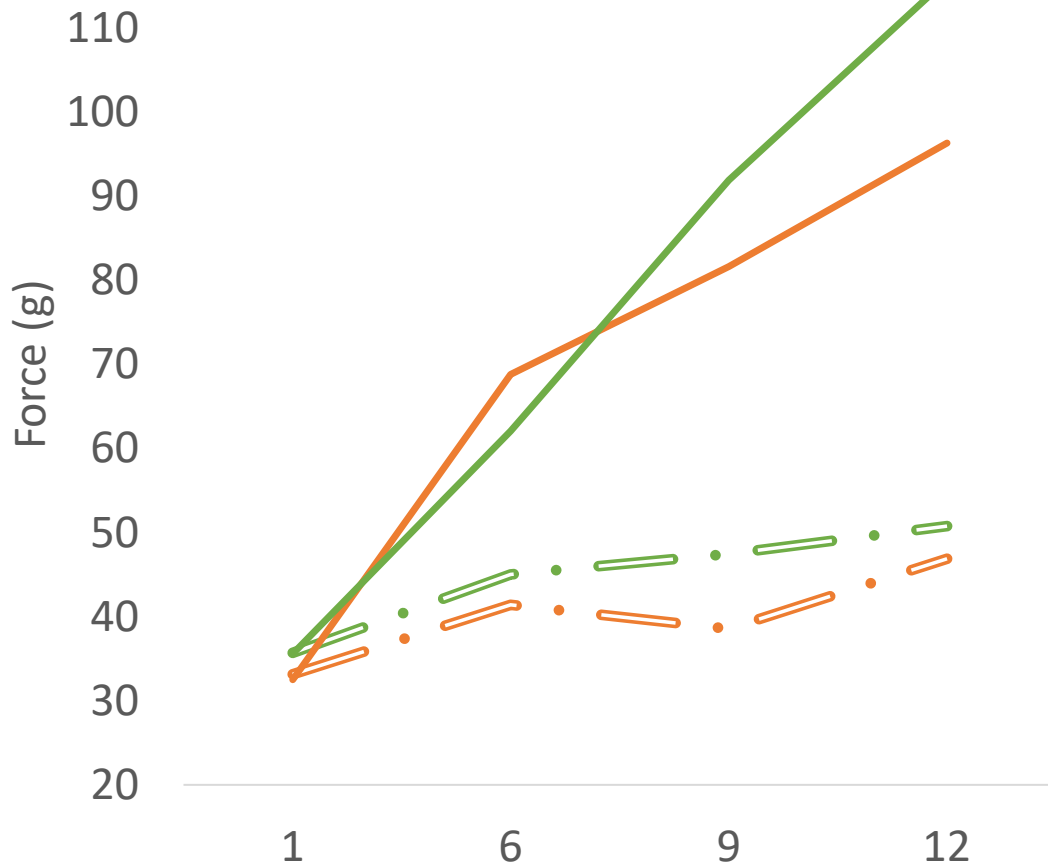


Free thiol groups in HD vs wild type sorghum as affected by cooking and oxidation

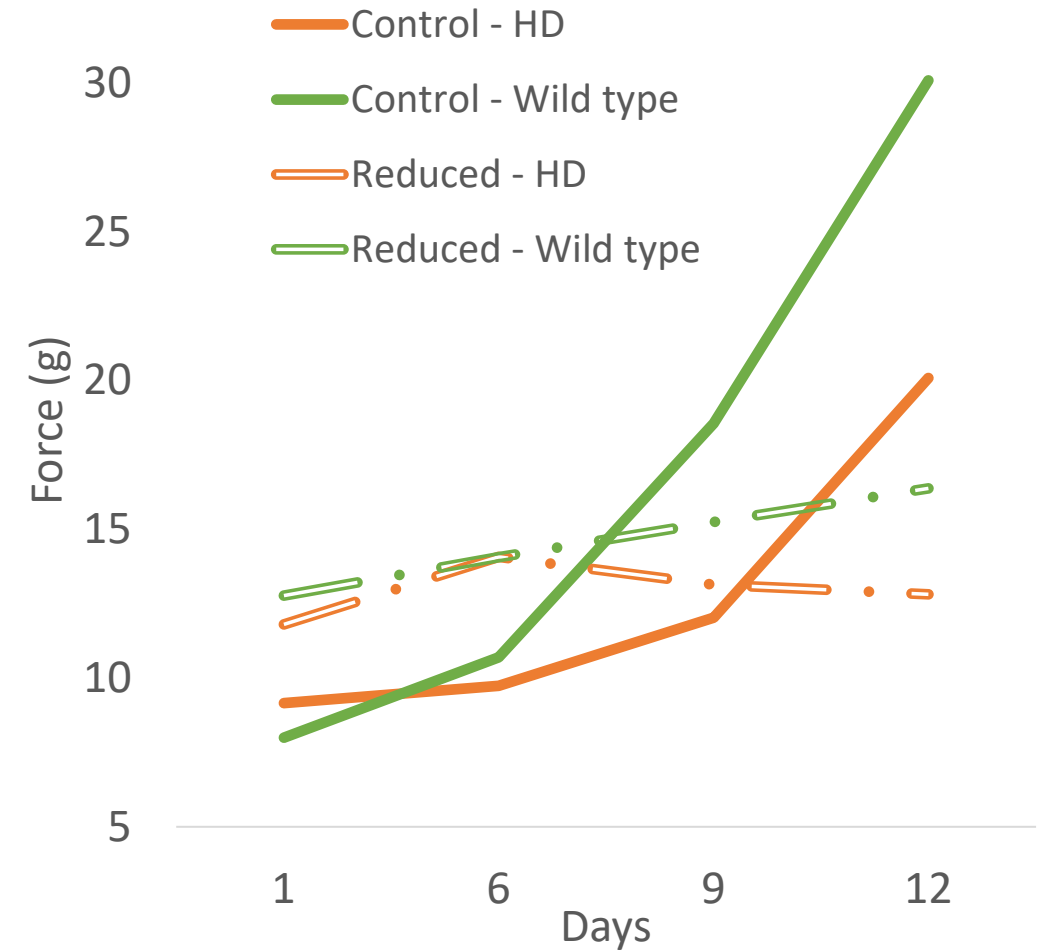


Effect of HD trait on gel hardness over time (starch retrogradation)

Maize starch + sorghum protein



Sorghum endosperm



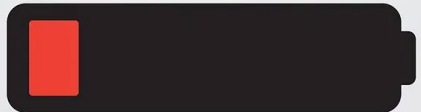
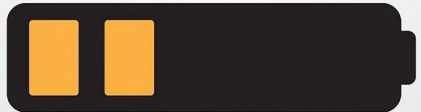
Lessons

- ❖ **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**

Issue and Concerns

- The production side is still slow due to the ongoing conflict

Capacity



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

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



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Thank you!

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