SHEA ROASTING IN A NUTSHELL

Brian Gylland (& Paul Means) Burn Design Lab ETHOS – January 26 - 28, 2018

urn

GN LAB



Agenda



- Background
- Problems
- Approach
- Potential Solutions
- Next Steps

Background

Shea is a fruit, and grows on trees scattered throughout the shea belt. There is no organized farming of shea trees. Women are the ones who primarily process shea, and the process is quite extensive with many energy, health, and ergonomic issues.







It's estimated that up to 900,000 women are involved in harvesting (mostly) & processing Shea in Gha alone.

Processing is the primary source of income for many women in Ghana and throughout the shea belt.

~ 60,000 women process shea in Ghana.

- 80% produce their own butter and sell it at market or use it personally.
- 20% produce butter at co-op facilities



Background - continued





Background – cont.

- BDL has partnered with Burro Brand Ltd. of Ghana to address the associated issues with roasting shea, and are working together to develop an improved roaster.
- Together Burro and BDL have been awarded a \$125K grant from Winrock Foundation





burn DESIGN LAB

Problems



- □ Inefficient:
 - Current methods use lots of firewood in poorly engineered roasters. The current methods are not insulated and have large fires with no air control.
 - Exhaust gas loss and losses due to convection and radiation are very large

DESIGN

Problems

- Not Optimized
 - Current methods are not optimized for achieving maximum butter yield.
 - Roasting time, temperature, and batch size are not controlled, which leads to large variability among roasted nuts.
 - Roasting drum/pot does not allow for even distribution of heat to kernels.





Problems

\Box Unhealthy

- Large open fires produce uncontrolled amounts of particulate and CO.
- Heat exposure from large fires is an issue
- Stirring and lifting cause many women joint pain in their necks, arms, and backs.





Cook Stoves vs Roasters



- This added dimension of optimization creates a new set of challenges:
 - Need for new procedures beyond the WBT for testing
 - Understanding how roasting parameters (time & temperature, heat rate) effect quality & yield.
 - Understanding the economics associated with quality & yield.

burn DESIGN LAB

Parameters & Goals

- A list of the established parameters and goals for the new roasting process, including cost, capacity, efficiency, durability, and emissions.
 - Eliminate smoke from roasting area (via stack)
 - Reduce fuel consumption by 60%
 - Reduce PM2.5 and CO by 90%
 - At least maintain and try to improve capacity (currently 50 min to roast 40kg of crushed nuts)
 - Durability goal of 2-3 years

Potential Solutions

- Creating a healthy environment:
 - Improving combustion efficiency and reducing PM2.5 and CO emissions will reduce time needed to gather fuel and provide a cleaner roasting environment.
 - The addition of a stack would remove harmful emissions from the roasting area, and prevent inhalation of particulate and CO.
 - Improving the means by which the kernels are stirred, and reducing the mass of kernels roasted will reduce the bodily pains and strains experienced by current methods.
 - Reducing the FP and radiant heat will reduce heat exposure.
- □ Resolving Inefficiencies:
 - Insulated device reduces convective and radiative losses.
 - Excess air control improves combustion efficiency/reduces fuel consumption.
 - Combustion Chamber with under fire air improves efficiency.
 - Maximize heat transfer to kernels.



Potential Solutions – cont.

Optimizing the Roasting Process:

- For highest extraction yield, determining the optimum roasting time and roasting temperature will be key.
- Roasting in small batches would lead to a more consistently roasted kernels within the batch.
- Constant FP to hold temperature and lead to consistent roast
- Reliable Temperature Measurement



Short Term Timeline

- Market Research underway
- Process Research underway
- Trip to Ghana in February/March
 - Conduct baseline field testing
 - Conduct/confirm market research
 - Establish relationships with shea processors for future prototype testing and eventual pilot testing
 - Establish relationships with local manufacturers

Thank You

Works Cited

- Honfo, Fernande G., and Anita R. LINNEMANN. "Influence of Roasting of Shea Kernels on Their Fat Content and Some Quality Characteristics of Shea Butter." *Journal of Food Studies* 6.1 (2017): 66-80. Web. 15 Dec. 2017.
- Mohagir A. M., Bup N. D, Abi C. F., Kamga R., and Kapseu C., "Optimisation of Kernels Preparation Conditions Involved in the Press Extraction of Shea (Vitellaria paradoxa Gaertner F.) Butter." American Journal of Food Science and Technology, vol. 3, no. 4 (2015): 103-110. doi: 10.12691/ajfst-3-4-2.

