Organic Protection of Cowpeas Postharvest Against *Callosobruchus maculatus (F.)* Using Shea Butter

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INTRODUCTION

Preserving nutritional value of local traditional foods for native children from harvest to harvest is vital to their health and development. Traditionally, Malian children receive vegetables and grain as main part of their daily diet, while male adults are given meat. Cowpeas are part of the diet of West African village children, but in many villages only eaten during 2 to 3 months after harvest because they are considered too difficult to prevent from destruction by cowpea bruchids, *Callosobruchus maculatus,* beetles spending entire larval and pupal stages inside cowpeas. This beetle species eats only cowpeas. Adult stage does not eat at all. Cowpeas, widely grown in West Africa, offer extra lysine, an essential amino acid lacking in the native children's diet of millet, sorghum and maize. Lysine offers more growth, mental and physical development in children. Lysine along with tryptophane, found in milk and grasshoppers (typical children's snack), will prevent kwashiorkor, a protein deficiency disease (Heikens and Manary 2009). Kwashiorkor is prevented because with lysine and tryptophan in the grain-based diet, complete proteins needed for normal physical and mental development can be built. There are many ways to keep bruchids from destroying cowpeas after harvest so they can be available all year round (Dunkel et al. 1998). Solutions adopted must be no cost and able to be produced in the village without using any unknown technology. Our collaborating scientist (K. Coulibaly 2007) shared stories of his mother and grandmother cooking cowpeas with shea butter, but peer refereed literature documents no such solution.

Hypothesis

Since shea butter is locally made by women from village shea trees, we hypothesized shea butter is a good candidate for organic protection of cowpeas against its main storage pest, *C. maculatus*.

Figure 1. Uninfested Cowpeas, *Vigna vinculata*

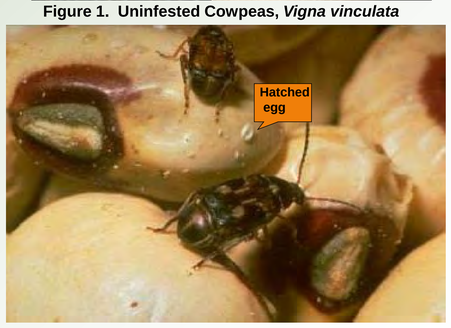


Figure 2. *C. maculatus* and hatched egg

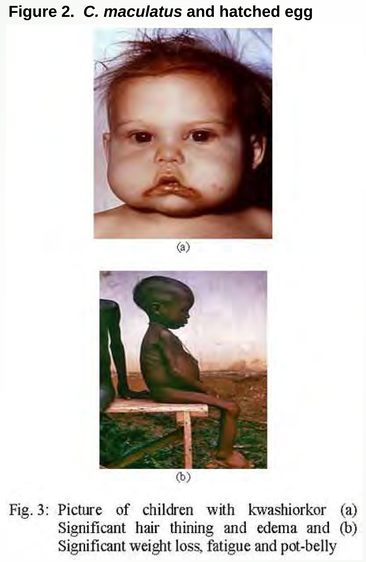


Fig. 3: Picture of children with kwashiorkor (a) Significant hair thining and edema and (b) Significant weight loss, fatigue and pot-belly

MATERIALS AND METHODS

MATERIALS/CONDITIONS FOR INSECT STOCK CULTURE

•US organic cowpeas from Community Food Coop-Bozeman
•*C. maculatus* collected March 21, 2008 in Sanambele, Mali from Hawa Coulibaly's cowpea storage harvested September 2007. Kept in stock culture environmental control chamber RH = 55+/- 3%; photoperiod 12:12::light:dark; 28 degrees C. +/- 1 degree.
•20 half pint mason jars with 50g organic cowpeas(wet weight)

BIOASSAY

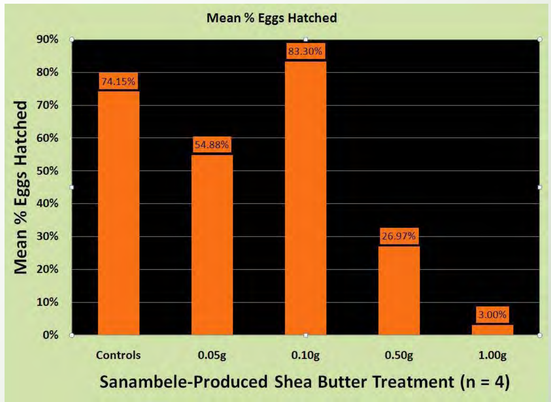
•organic shea butter from Sanambele's Women Shea Butter Coop
•10 female *C. maculatus* ((2)0-24 hours, (3)24-48 hours and (5)48-72 hours post emergence of adults) per jar,
•4 replicates included a control plus 1 of each of the following treatments:
•0.05g, 0.01, 0.5, 1.0 g shea butter/ 50 cowpeas
•Mixed organic shea butter by first melting on a hot plate and applied to 50 g cowpeas only.
•After mixing each organic shea butter concentration level to the organic cowpeas, picked only 50 whole cowpeas to add to the half pint mason jars.
•After cowpeas cooled they were inoculated with 10 female *C. maculatus*
•2 females (0-24) hours post adult emergence
•3 females (24-48) hours post adult emergence
•5 females (48-72) hours post adult emergence
•After all 20 jars were inoculated, they were placed in an incubator at 28 degrees C., 60% RH.
•Observations were made 1 hour, 15 days, 20 days, 25 days post-treatment. For each cowpea, individually , # eggs laid, hatched, and emergence holes were determined. If no emergence, embryonic stage when death occurred was recorded.

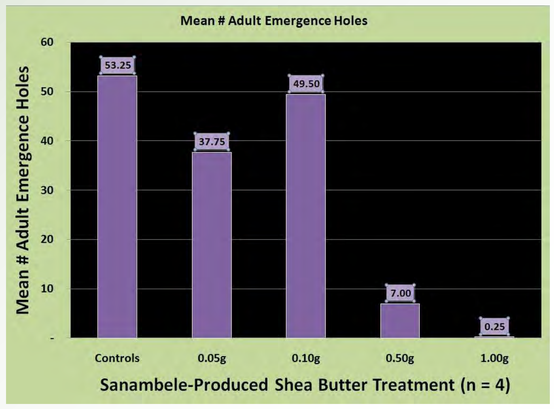
Figure 4. Ashley Alvarado and Dr. Florence Dunkel weighing 50 g of cowpeas for bioassays.

RESULTS

Shea butter prevented *C. maculatus* from entering the cowpea as a hatchling. *C. maculatus* laid 50% less eggs on treated cowpeas compared to controls, but embryos did not reach full development. Cowpeas were not nutritionally destroyed by *C. maculatus* when coated by 1g shea butter per 50 cowpeas.

Sanambele-Produced Shea Butter Treatment (n = 4)	Mean # Eggs Laid	Mean % Eggs Hatched	Mean # Adult Emergence Holes
Controls	101.75	74.15%	53.25
0.05g	149.00	54.88%	37.75
0.10g	132.00	83.30%	49.50
0.50g	84.25	26.97%	7.00
1.00g	52.25	3.00%	0.25





DISCUSSION

Why will adoption of shea butter to preserve cowpeas from harvest to harvest be easy for village women?
Shea nuts are owned by village women. Shea butter is locally made from the nuts in the villages by West African women. Since it is an organic material, a butter made by village women from the nut of the shea tree, shea butter will have a chance to be adopted. Villagers do not like using unknown technology. Plus, shea butter is already used for cooking cowpeas.

What will this mean for the children of Sanambele and other villages where at least one-fourth or more of the kids are at risk for kwashiorkor?
Organic protection of cowpeas, against their main storage pest, *C. maculatus,* will allow cowpeas to be preserved harvest to harvest. This means that the children who are at risk for kwashiorkor can lower their risk by eating cowpeas year-round. Along with a glass of milk (providing the amino acid, tryptophane, missing in cowpeas), this will prevent kwashiorkor.

Is this sustainable? Does this pest management solution require any outside input?
This is a sustainable solution to pest management because it requires no outside input, and no new technology. Shea butter used is made by the women in the village and used in cooking cowpeas. Everything the villagers need to use these ideas are at no cost to them, except the minor labor to coat the cowpeas.

Are there any risks to the mothers or kids using this method of pest management?
The shea butter pest management solution is a no-risk solution. The only risk would be not to practice these methods.

Are there any take-away messages for any other native or non-native peoples?

Organic farmers or persons looking for a solution to similar safe, no-cost pest management problem and/or nutritional problem can find simple, effective, organic s[illegible]

Figure 5. Sanambele girl holding container of shea butter.

Figure 6. Sanambele child with kwashiorkor (top - note reddish hair) and at-risk for kwashiorkor (bottom - in green and white dress).

Figure 7. Changing the record chart for the 7-day, continuous recording thermo-hydrograph in the environmental chamber where both mass cultures of bruchid beetles are kept and the bioassays are conducted.

CONCLUSIONS

As long as cowpeas are protected against *C. maculatus,* native villagers may safely store cowpeas and serve them, from harvest to harvest, to their children to prevent kwashiorkor. Shea butter is a local, "at-home", no-cost, safe, protection method for cowpeas in Malian villages, and throughout Sub-Saharan Africa where shea trees grow and cowpeas are eaten.

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