Shea Nut Processing

Silver B

Mock-Up Review
October 18, 2007
Customer Contract

Product Description:
A bicycle-powered shea nut mill

Customer:
Small-scale shea nut producing villages in sub-Saharan Africa

Market:
Fair-trade agricultural products

Cost:
Customer can afford $150 for a multiple-family unit
<table>
<thead>
<tr>
<th>Customer Needs</th>
<th>Product Attribute</th>
<th>Engineering Specification</th>
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<tbody>
<tr>
<td>Helps with shea butter production process</td>
<td>▪ Turn shelled shea nut into paste</td>
<td>▪ Grain size &lt; 1mm</td>
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<tr>
<td>Improvement on traditional methods</td>
<td>▪ Faster than mortar &amp; pestle</td>
<td>▪ Output &gt; 1.2kg/hr</td>
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<tr>
<td></td>
<td>▪ Faster than mortar &amp; pestle</td>
<td>▪ Input Power</td>
</tr>
<tr>
<td></td>
<td>▪ Require low power &amp; pestle</td>
<td>▪ Output &gt; 1.2kg/hr</td>
</tr>
<tr>
<td>Manufacturable &amp; repairable locally</td>
<td>▪ Made from locally</td>
<td>▪ Steel fastened</td>
</tr>
<tr>
<td></td>
<td></td>
<td>with welds</td>
</tr>
<tr>
<td></td>
<td>▪ Made from locally available materials</td>
<td>▪ Reproducible by Ghanaian smiths</td>
</tr>
<tr>
<td>Comfortable to use</td>
<td>▪ Ergonomic design</td>
<td>▪ Use 2 hours w/o pain or discomfort</td>
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Risks and Issues

• What are the Power Requirements?

• How Easy is it to Use?
What is the Best Way to Grind?

- Auger-fed mill
Press (compression only)
Gravity-Fed Mill

“I knew MIT kids could not have designed this to be the real thing.” -Anonymous User
Press & Grind

“The nuts developed a smooth finish.” - Brad
Auger Fed Mill

“Hey, shea butter.” -Karen
Grinding Method Comparison

Using our sketch model (the press) as a baseline

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<tr>
<td>Reliability</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Paste Quality</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Constant Feed?</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Output Rate</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>+</td>
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</table>
How much Power is Required?

Shea Nut Auger-Mill Power Consumption

Power (W) vs. time (min)

Power = Torque * Angular Velocity
Is it Easy to Use?

Enticing Sign  Nut Grinder  “Do not eat…” Sign

Bowl of Peanuts  Empty Bowl
Conclusions

• Best way to grind? Auger & Mill plates

• Human Powerable? Yes

• Intuitive to use? Yes
Initiation

- Harvest fallen nuts
- Remove Fruit by Burial **12 days**

Removing moisture for easier shelling

- Parboil
- Roast or Sun Dry **3-4 days**

Making paste for easier oil extraction

- Roast, Stir constantly with heavy stick **3-4 hours**
- Pound w/ Mortar & Pestle **30 min**
- Ground to Paste (**3-5 women w/ giant mortar & pestle, or several women with grinding stones**)  

- Add Water and Knead by Hand **30-90 min**
- Remove Fat from Emulsion Using Large Spoon
- Wash Fat Repeatedly
- Boil Fat Repeatedly
- Decant Repeatedly
- Stir Constantly
- Stir & Cool Decanted Butter

Extracting the oil – best non-chemical results by hand