Pomegranate Brandy

Final Report
December 4, 2005

18 graos
Albert Chu
Matthew Ng
Amos Zhang
Contents

Summary........................................................................................................................ .............3
Deliverables ..................................................................................................................................4
  Juice Press...............................................................................................................................4
  Pomegranate Wine ..................................................................................................................6
Business Plan..........................................................................................................................8
Challenges and Lessons Learned.................................................................................................9
Future Work..............................................................................................................................11
Summary

This report summarizes the progress of team 18 graos at the end of the 2005 E/ME 105 course. First will be a discussion of our deliverables. All planned deliverables were completed, including the juice press, pomegranate wine, and a business plan. Various problems in these deliverables will be discussed, and suggestions will be made for future prototypes. The second section will talk about major challenges we encountered throughout the project, as well as important lessons learned in the process. Finally there will be a summary of possible future work related to this project.

Please refer to the business plan for detailed information on the product concept, business model, financials, and target market. The information included in that document will not be repeated in this report.
Deliverables

Juice Press

Our fruit crusher includes two main parts, first we have a grinder for softening and shredding the fruit, and second we have a rack and pinion based press. We think that this design will be able to satisfy our product requirements, our sustainability requirements, and also our human factor concerns.

Current hand operated fruit press designs operate on one of two ways based on the quantity of fruit to be crushed. If it is just crushing a single fruit, then a simple lever is used. For crushing more than one piece of fruit, a screw based mechanism is often used. Initially we also planned to use a screw based press, but after speaking with John Van Deusen about the availability and requirements for working with such a screw, and speaking with Mario Blanco about what kinds of resources would be available in Guatemala, we realized that a screw might not be very practical.

Instead we settled on a much simpler, rack and pinion mechanism. This solution also helps us to satisfy our sustainability concerns because in addition to being much cheaper and easier to work with than a screw, the rack can be created from parts from “junked” cars. We hope to be able to scavenge the shafts for the rack and the axles in the car for the pinion. For the teeth of the rack, and the teeth of the pinion gears, we will use steel pins removed from the roller bearings used in the wheels of the same junked cars. The rest of the framework of the press does not have any major strain requirements, so it can be constructed out of wood, or perhaps out of large scrap pieces from the car as well.
Our press is extremely intuitive to use. Because the press itself is exposed, it is easy for people to see how it works. We will also include steering wheels (if we can find ones with large enough diameters) for the handles to be turned, which should make it very simple for the workers and should be fairly comfortable to work with (assuming the steering wheels were designed with that in mind). Our press will stand just under two meters tall, but the actual parts that will require human interaction and the parts that will need to be cleaned are all at or below 1.3 meters.

We have not measured the forces needed to crush a whole pomegranate, nor have we measured the forces needed to crush a shredded pomegranate, but we found some studies about the forces needed to crush apples, and if we assume that apples and pomegranates both require forces on the same order of magnitude, then our press should be able to crush the whole fruit (and if so then it should be able to crush the shredded fruit even better). The torque needed to operate the press was calculated to be roughly the same as the torque that a racecar driver needs to apply to his car steering wheel to maintain a straight path. After building the prototype I realized that I did not include the weight of the rack and the pressing plate. This might have an effect depending on the material used for the pressing plate, but it will be working in our favor and helping to crush the fruit, so it can be treated as an extra safety factor.

On the whole, our system does not have any very dangerous parts. The most dangerous part is the grinder, but we plan to include a 30 centimeter removable cover for the grinder that will be required for operation to ensure that the person feeding in the fruit does not have to reach near the grinding gears. It will be removable to allow for easy cleaning afterward.
**Pomegranate Wine**

A sample pomegranate wine was successfully made using approximately two weeks of time. One gallon of unpasteurized pomegranate juice was purchased for this purpose. The container that carried the juice was converted into a simple fermentation chamber. Yeast was added to the juice, and it was placed in a cool, shaded area of the room for fermentation to proceed. After fermentation ended, a chill treatment was attempted to improve the taste. After this treatment, the wine was bottled in our custom glass bottles, and brought for people to sample.

The makeshift fermentation chamber involved attaching an airlock to the cap of the juice container. Fermentation must take place in an anaerobic environment for best results, and at the same time, carbon dioxide produced during the process must be allowed to escape. A hole was cut in the cap, and a flexible plastic tube was put into it for gas to escape. Plastic cement was used to seal the gaps around the tube. The other end of the tube was submerged in a small container of water. This was an effective airlock construction, and gas bubbles were easily detectable in the small water container during fermentation. The only problem was that the tube used was too small, so that not all of the gas was able to escape. Most of the remaining gas escaped either during bottling, or was shaken out during the transportation of the bottles.

The yeast used for fermentation was just common baker’s yeast. There was not enough time to identify and purchase more appropriate yeast. While this yeast was able to ferment the juice, there were two problems that could be identified. First, the final alcohol content level was unknown. However, this could have been measured using a hydrometer instead, but we did not have that instrument available either. Second, this yeast carried an unpleasant smell, which was very noticeable when the container was first opened after the completion of fermentation. Fortunately, this odor wore off in the next few days. Other yeasts may carry other odors, and
more experimentation will be required to determine which yeast can contribute a pleasant aroma to the wine.

After fermentation was completed, there were two obvious negative characteristics of the wine which required further processing. First, there were many unsettled particles in the wine, which gave it a cloudy appearance. This is a common occurrence in home winemaking, and there are standard settling tablets. However, it usually takes up to two weeks for these methods to be used effectively, which was more time than we had. Second was that the wine tasted very acidic. Much of this was caused by the mentioned unsettled particles. An alternative treatment for decreasing acidity in wine is to chill it. This treatment required the wine to be placed in an environment at least 10 degrees (Fahrenheit) cooler than the temperature during fermentation, which basically meant that it needed to be placed in a refrigerator. After two days, there was a noticeable reduction in the acidity of the wine, although part of this was probably because the wine was allowed to settle a bit more at the same time.

For packaging, custom pomegranate shaped bottles were made by Glass Instruments Inc., a glass specialist located in Pasadena. These custom bottles demonstrated the concept well. There a few possible points for improvement in future prototypes. First, the diameter of the bottle should be reduced to make the bottle easier to hold. The current bottle also holds much more than the standard 750 mL. Second, a thicker glass can be used to make the bottle more appealing. Finally, the opening of the bottle should be enlarged to facilitate pouring. Overall, these bottles were quite a hit.
Business Plan

The completed business plan exceeded our original expectations. However, it was finished late in the project, so there was not enough time to get feedback on it. We found a business plan for producing cashew apple brandy in Mozambique, and we originally intended to base our own business plan on that document. However, upon closer examination, it seemed that the Mozambique business plan was over simplified. We believed that our business plan could be much more in depth.

An outline of a complete business plan at Inc.com was used to guide the writing of our business plan. The finished business plan begins with a summary of the business. Next is a discussion of our vision and the business goals. The next sections describe in detail the target market, the competition, and the implementation strategy. Then there is a description of our products and services, followed by marketing strategy, and an outline of the entire business operation. The last section is a financial analysis.

For comparison, the Mozambique cashew apple brandy business plan is available at: http://www.unido-aaitpc.org/unido-aaitpc/new1/mozambique/cashewapple.pdf
Challenges and Lessons Learned

As previously discussed, the first problem we faced was the unavailability of cashew apples. Cashew apples are extremely difficult to obtain in the United States, since they can only grow in the climate of southernmost Florida. The fruit is also harvested in spring, so it is impossible to find at this time of year. It is because of this issue that we decided to switch to working with pomegranates, at the recommendation of Luz Delgado.

The switch to pomegranates eventually presented to us an added challenge of cost. We mistakenly believed that because we are building a high value product, cost would have been less of an issue. Pomegranate fruits have high retail value, so a first calculation of production costs showed that raw materials along would total to more than $10.00 per bottle. We were thus convinced of the need for cost cutting, something Paul Polak cared most about. At the same time, we looked much closer at the issues of sustainability and appropriate technology. Fortunately for us, John Van Deusen was also aware of the importance of sustainability in our project, so he was able to help us identify junk car parts that we were able to use in our juice press.

Another major problem we faced was the loss of a group member. Aside from being another member to share the workload, he was also our chemistry expert. His departure meant that we could no longer focus on any of the many chemistry related issues in this project. Working with our available expertise, we decided to concentrate instead on the mechanical aspects of the project, and make a juice press.

An important lesson that we learned is the importance of teamwork, especially after the loss of a group member. The lack of initial organization led to inefficiencies such as extended meetings and incomplete tasks. The lack of clearly defined member roles and responsibilities
was also partly responsible for the departure of our fourth team member. Following the advice of Sky Marsen, we were able to reorganize our team and continue the project.

The one problem that we were unable to resolve was finding contacts in Honduras. Initially this problem was caused in part by our poor team organization. No one felt responsible for tasks of contacting people. However, even after our team became organized, this problem still remained. It was very difficult finding people who we could contact, and it was even more difficult to get responses from those contacts. In one case, Mario Blanco introduced us to a friend of his who currently teaches in Honduras. We contacted him, and even got a response that he would be able to answer our questions within a few days, but we have not yet gotten a response with those answers. If we were to work on a similar project in the future, this would definitely be an area that we would focus more on.
Future Work

The work done by 18 graos is a great start on this project, and future work is definitely possible. Further work needs to be done with equipment design and testing, alcohol making, and market research. This report and the business plan will be very useful for future teams working on this project.

During this term, we designed and implemented equipment for juicing and fermentation. In the future, designs will be needed for the still. Designs for stills are available online, but they do not necessarily use “junk” parts. The design should also focus on simple assembly. There also needs to be a set of simplified testing and measuring instruments, such as an easy to understand hydrometer. Finally, there needs to be aging tests done with used oak barrels.

Many different experiments can be done with the making of the alcohol. First, different yeasts should be studied and tested. Post-fermentation treatments, for settling and for taste improvement, should also be tested. Finally, a confident group with a chemist should attempt distillation. Poorly controlled distillation can produce high concentrations of methanol, which is a health hazard.

Future groups working on this project should attempt to conduct market research on a Central American country. This alcohol does not need to be produced in Honduras, since conditions in most Central American countries are very similar. In fact, Guatemala may be a better candidate for this project, since it is easier to establish contact with Guatemalans. More understanding of a Central American market can lead to better use to labor as well as details on how to establish our secondary market.