# Montana State University Food Product Development Lab

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## Lab Background

MSU's Food Product Development Lab (MSUFPDL) is a lab dedicated to nutritional health and food sustainability. From crickets to pulse crops the lab has used local resources in Montana to create healthy and sustainable products. The new extrusion lab, in which this project is based upon, will soon be producing lentil based pasta, cereal, and puffs.

**"Working in MSUFPDL has been a great experience because I've learned so much about the development of new products. This lab has pushed me to explore every input to the development of a successful product."-GB**

## Project Background

Montana is a leading producer of pulse crops, to take advantage of these local resources MSUFPDL has installed an extruder with the goal of developing consumer accepted pastas, snacks, and cereals. Each product will be made from lentil flours from local growers rather than traditional commercial wheat or corn flours. With the lab preparing for production the goal is to identify where areas of water and energy waste may occur and begin strategizing how to potentially measure and lower those wastes.

## Incentives to Change

The MSUFPDL is committed to producing sustainable foods for consumers. Part of maintaining a sustainable product is reducing the environmental impact of its life cycle, while also producing a healthy and delicious product. In analyzing the lab there are hopes of preparing methods of production that allow for a safe, low cost, and effective research experience.

**Sustainable food product development – sourcing local, specialty, and Indigenous crops to create healthy, eco-friendly, and culturally acceptable food products. "**

**-Dr. Wan-Yuan Kuo**

# Recommendations

### Fix green hose

A hose used to clean the facilities after production has a bad connection with the nozzle and therefore leaks about half the water supply. To save water and make the cleaning process easier and safer for workers, it is recommended to attach a new nozzle, find a connecting piece, or find a hose that fits the nozzle correctly.

### Investigate energy usage

To investigate the amount of energy usage of the extruder we could potentially install an electric meter. This would allow me to determine the most efficient parameters of the extruder and measure any energy losses due to lacking insulation within the barrel. The energy usage of the rest of the lab including iPads, lighting, and water pumps will also need to be measured and reduced accordingly.

### Investigate cooling water waste

When production through the extruder is complete there is a flow of cooling water that is sent down the barrel to clean and cool the tubes. This water volume will be measured based off the time and flow rate used. Through production we can lower the time and flow rate in increments to determine what is most effective while also utilizing the least amount of water.

### Design a water efficient cleaning system

To design a water efficient cleaning system, different methods of cleaning will be measured while measuring the amount of water used in each process to find the most water efficient process. Two of the more water intensive procedures involved are cleaning the floors and cleaning the extruder screws. Some effective methods to test would be sweeping before spraying, soaking, and using different cleaning products.

### Investigate start up method for extrusion

To begin production the extruder takes time to turn on and reach the desired parameters (temperature, rpm, mass flow rates, pressure). It was observed that during the stages that lead up to reaching these parameters there can be distractions that lead to the process taking more time and energy than required. To potentially decrease this downtime, we can investigate a method of timing out how long the extruder takes to reach the next set of parameters so that we can set timers and be more prepared.

### Investigate heat loss of barrel

Determining the energy inputs and outputs of the extruder can help determine the amount of heat lost in the barrel during extrusion. If large amounts of energy are lost within the barrel, we could consider the purchase of an insulation blanket, which increases insulation and provides another layer of safety for students in the lab.

# Recommendations (Continued)

## Design an efficient process flow

In the lab space there is a small walkway between the extruder and rollaway ladder. Since the walkway is small, crowded, and close to the hot barrel of the extruder, it would be in the labs best interest to avoid that space within the process flow as much as possible. Therefore, I have proposed we store ingredients in the first storage room (closest to the entrance), while storing all finished product in the second storage room closest to the back of the room. With this method product can be moved out of the lab after production, when the extruder barrel has cooled down and the ladder can be moved.

| Recommendation | Approach |
|---|---|
| Fix green hose | Replace nozzle or hose |
| Investigate energy usage | Install electric meter |
| Investigate cooling water waste | Determine flow rates and times to find volume of water |
| Design a water efficient cleaning system | Test different cleaning procedures while measuring water usage. Identify the most effective and water efficient cleaning method |
| Investigate start up method for extrusion | Create a timing system that minimizes the downtime before and after production |
| Investigate heat loss of barrel | Calculate a heat balance around the system |
| Design an efficient process flow | Test my purposed process flow |