Vegan recipe expands range of promotional baked pastry products

**Background**

Kellogg is a global food manufacturing company headquartered in Battle Creek, Michigan. One of their most popular products is a baked filled pastry. These are frosted toaster pastries with a sweet filling and a pastry crust. Kellogg offers promotional products, which are pastries with an edible printed image on top of the icing.

Kellogg aims to continue production in pastry plants without stopping to produce only 200-300 cases of promotional products. Currently the pilot plant process has issues with pastries sticking together in packaging due to a lack of drying time. The team was tasked with redesigning the pilot plant pastry line to be able to produce promotional products.

**Objectives & Constraints**

The project objectives are to:
- Determine method to increase cooling time
- Produce 200-300 cases per production run
- Increase the number of production runs

The project constraints are:
- Cool pastries to < 110°F before packaging
- Cool for at least 12 min
- Space for pastries to cool within 50 ft²
- Meet Kellogg’s quality standards for icing
- 1-2 annual production runs in pilot plant
- Comply with 21 CFR Subchapter B

**Standards & Regulations**

The design alternatives must comply with the following FDA food safety standards and regulations:
- 21 CFR § 110 – Good Manufacturing Practices
- 21 CFR § 120 – Hazard Analysis Critical Control Points
- 21 CFR § 150 – Fruit and Jelly Products

Equipment that could be introduced in the pilot plant must be food grade. Food grade stainless steel includes:
- SAE 200, 300, 400 series
- Chromium-nickel-manganese alloys

**Design Alternatives**

Cooling Tunnels
- Minimal space requirement
- Expensive to purchase new equipment
- Minimal increase in drying time

Additional Spiral Cooler
- Increases drying time to 14.5 min
- Requires most space
- Expensive to purchase new equipment

**Selected Design**

The selected design was the icing modification. To determine what icing to recommend to Kellogg, a home icing trial was conducted, followed by a trial in the Kellogg lab.

**Home Icing Trial:**
Three icing formulas were tested:
- Aquafaba
- Gelatin
- Combination of gelatin + aquafaba

**Aquafaba**

Aquafaba is the residual liquid of the water chickpeas have been cooked in and is capable of gelling and thickening (Yazici, 2022). It adds no additional taste and is a vegan ingredient.

Results of the sensory evaluation are shown in Figure 4, a 9-point Hedonic Scale was used to evaluate the 6 criteria which included: flavor, texture, aroma, sweetness, appearance and overall acceptability. Results indicated that the aquafaba recipe was the best recipe to move forward with.

**Economics**

The team calculated payback period for equipment and cost of ingredients for the icing modification.

**Table 2. Equipment Payback Period**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>$0/yr</td>
<td></td>
</tr>
<tr>
<td>Capital Cost</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>Recurring Costs</td>
<td>$10,000</td>
<td>$/year</td>
</tr>
<tr>
<td>Payback Period</td>
<td>11.4</td>
<td></td>
</tr>
</tbody>
</table>

Both cooling tunnels and spiral coolers were given the same estimated range of pricing. The team calculated the payback period for the equipment conservatively, using the higher estimated price. Ultimately the payback period was calculated to be 11.4 years. This exceeded the preferred payback period of 5-10 years.

**Table 3. Ingredient Cost Comparison**

<table>
<thead>
<tr>
<th>Description</th>
<th>Aquafaba</th>
<th>Gelatin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastries/Year</td>
<td>518,400</td>
<td>518,400</td>
</tr>
<tr>
<td>Cups /Order</td>
<td>64</td>
<td>37</td>
</tr>
<tr>
<td>Orders/Year</td>
<td>180</td>
<td>171</td>
</tr>
<tr>
<td>Cost/Order</td>
<td>$/year</td>
<td>$/year</td>
</tr>
</tbody>
</table>

Cost of aquafaba will be around 5 times the price of gelatin annually. This is due to the recipe modification calling for 8 times as much aquafaba as gelatin. The recipe modification is still the least expensive design.

**References**


