Title: Development of a blueberry sorting machine

Authors: CASTILLO-SUROZ, Gregorio, LIMON-DIAZ, Miguel Ángel, CRUZ-GARRIDO, Arnulfo and VERGARA-REYES, Ángel Vidal
Introduction

Blueberry is a berry type fruit in a spherical shape of one or two centimeters, which has many properties: "It is a fruit rich in fiber, astringent, diuretic and also has vitamin C and vitamin K. It is a natural antioxidant and also helps maintain optimal brain function and vision. It is a natural antioxidant and also helps to maintain in optimal conditions the functioning of the brain and eyesight".

In the Sierra Norte of the State of Puebla, particularly in the municipality of Zacatlan, they have focused over time to produce blueberries, so that in 2009 they became the first in the entire region to receive the certificate of organic crops in its entirety: "Currently, they are the largest producers in Puebla, with 88 tons that are exported to the United States and Canada".

The growing demand for products in international markets makes it mandatory to comply with increasingly demanding quality standards, so producers in these communities have found it necessary to acquire machines that compensate for the lack of labor, save time and increase the quality of the final products compared to conventional manual processes.
The purpose of this project is to detail a methodology for the development of a blueberry sorting machine according to its size, by means of a mechanical-electrical system. The machine presents a mechanism that fulfills an adequate dosage by size and the preservation of the texture of the fruit.
Methodology

Field survey: Based on the request made by the interested parties with the sorter, a type of mechanical-electrical machine is required that can sort blueberry fruit by size, with the objective of reducing a sub-process applied to the product.

Philosophy of operation: In this process of researching the characteristics and specifications of blueberry fruit, the standards and types of classification were collected, seeking information from national standards.

Prototype design: After having studied and gathered the necessary information on the requirements and operating philosophy for the blueberry sorting machine, we proceeded to present the prototype of the machine using the SolidWorks design software (SolidWorks).

Prototype manufacturing: After following all the steps mentioned above, we proceeded to manufacture the prototype.
Results

Scope of the project

- It has a banding system that keeps track of fruit size.
- The electrical source is 127 v.
- The machine has 4 types of fruit sorting.
- It speeds up the sub-process and preserves the fruit blum.
- The machine is operated by a trained operator of legal age.
- A user's manual on the use of the sorting machine is available.
Results

- Limitations of the project

  - Users may only have one sub-process of everything involved in the fruit.
  - The configuration of the calibration of the belts can only be performed by authorized personnel.
  - The project does not include maintenance of the sorting machine.
  - The mobility of the machine is carried out by two or more people.
Results

Graph of manual sorting times compared to the sorting machine.

<table>
<thead>
<tr>
<th>Time</th>
<th>Manual Selection</th>
<th>MSB (Blueberry Sorting Machine)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 min</td>
<td>3.26</td>
<td>17.142</td>
</tr>
<tr>
<td>20 min</td>
<td>6.52</td>
<td>34.285</td>
</tr>
<tr>
<td>30 min</td>
<td>9.78</td>
<td>51.426</td>
</tr>
<tr>
<td>40 min</td>
<td>13.04</td>
<td>68.568</td>
</tr>
<tr>
<td>50 min</td>
<td>16.3</td>
<td>85.71</td>
</tr>
<tr>
<td>60 min</td>
<td>19.56</td>
<td>102.852</td>
</tr>
</tbody>
</table>
Once their operation was demonstrated, the blueberry sorting machines were delivered to the community of Xoxonacatla Zacatlán Puebla, Mexico.
The study of the blueberry sorting machine demonstrated advantages over manual fruit sorting, optimizing time and movements in the sorting and packing process. This benefits growers while protecting the integrity of the fruit during the process.

The fruit selection stage is considered crucial, which led to the integration of a specific system for this process. Using data collected from blueberry growers, a model was created covering structural and mechanical-electrical aspects, culminating in the fabrication of the corresponding prototype.

Once the tests were successfully completed, the equipment to be delivered to the producers was manufactured in series, and at the same time the manuals for operation, failure and repair of the equipment, as well as user training, were prepared.
References


