Cooling represents a high cost in energy consumption and the food processing industry is one of the industrial sectors with the highest demand. The cold chain needs to be maintained from factory to consumers to help extend and ensure the shelf life of products [1]. Unfortunately, the use of these systems sometimes proves to be out of reach for small producers considering the use of conventional refrigeration systems implies a high cost in electricity consumption. In addition, the power supply in many countries can be unstable or erratic, with some countries even having frequent black-outs. The objective of this project is to conduct a theoretical and experimental study of photovoltaic cooling systems, and unconventional storage systems such as phase change materials (PCMs), optimizing their configurations and providing them with greater autonomy to be used in the food industry, particularly in preserving fruits of high value-added in order to meet export standards [2]. A cold storage system based on PCMs was studied experimentally in terms of dynamic performance and capacity to provide the appropriate preservation conditions for fruit. To this end, a solar cooling system consisting of a cold chamber incorporating PCMs was implemented. The cold chamber was driven by a conventional compressor connected to the electric grid and to a field of photovoltaic modules using an on-grid inverter. The study results demonstrated the capacity of PCMs to reduce the energy consumption from the grid and to minimize the mismatch between solar energy availability and cooling demand. On the other hand, the effect of PCMs on temperature and humidity distribution within the cooling chambers ensured their beneficial effect on fruit properties and quality.

References: