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## Church Brothers, LLC- Condensation Control in Fresh Cut Items

The manifestation of condensations inside bags may occur during handling and transportation. In order to avoid or mitigate the issue, we need to understand the root cause:

1. Produce: fresh produce is alive, and therefore it “respires” to keep this living state. This biological process is known as “Respiration” and involves the breakdown of carbohydrates to produce the energy to run cellular processes. Throughout this process, oxygen is consumed and carbon dioxide, energy (give-off as heat) and water vapor are released.
2. Respiration rate: There are times of the year when produce respires “faster” than usual. This is normally a consequence of a stress. These peaks may correspond to warm periods combined with larger photoperiods (number of hours of light) which results in a very fast growing rate (= stress), end of season and transition times. Overall, the higher the respiration rate, the higher the heat and water vapor production.
3. Package: Packages are designed to keep the quality of the product and extend the shelf-life. Relative humidity (RH) inside the packages is normally very high (90-95%). Maintaining the RH high is important as it reduces the transpiration of water from the produce, thereby reducing wilting, and loss of firmness.
4. The accumulation of vapor in the package depends on the rate of water loss from the product (respiration and transpiration rate), the water vapor transmission rate (WVTR) of the film (ability of the film to release water vapor from inside to outside of the package), and the external environment temperature (cold chain fluctuations).

### MITIGATION ACTIONS

1. Respiration Rate: In order to reduce the respiration rate of the raw product, we have implemented the following actions:
  - a. Reduction of Cut-to-Cool times to 4 hours maximum.
  - b. Strict temperature control monitoring of all the raw product before processing.
2. Package: Our package is designed to avoid excess humidity by using a specific film structure that provides sufficient WVTR. In addition, our package also provides a modified atmosphere environment that reduces the respiration rate of the product.
3. Cold Chain: The RH in sealed packaging is near the saturation level. Therefore, small fluctuations in temperature during storage or shipment may result in water condensation on the surface of both film and produce.
  - a. True Leaf Farms:
    - i. Raw and WIP product: Temperatures of raw product, environment and flumes are strictly controlled and below 35°F.
    - ii. Finished Product: Strict temperature control of finished product. If needed, finished product pallets are transferred to air-forced cooling tunnel to guarantee a product temperature below 35°F.
    - iii. Loading operations: QC personnel monitors product temperature before loading the refers. Only pallets with product temperatures below 35°F are loaded.
  - b. Shipping:
    - i. Temperature fluctuations (avoidable and unavoidable) may result in condensations on the inner surface of the package.

If you may have any additional questions, please contact us at [foodsafetyquestions@churchbrothers.com](mailto:foodsafetyquestions@churchbrothers.com)