By Professor Richard Beyer
Food Scientist
richard.beyer1946@gmail.com

THEORY OF DRYING

Food is made up of a large number of components which are largely fat, protein, sugar, starch and water. They vary in each of these proportions obviously and have nutrients in them. Each component behaves very differently. Protein and fat do not interact with water but carbohydrates including sugar do. If a component interacts with water then that water becomes unavailable to bacteria. As you know meat will not keep because it is largely protein and does not interact with water, jam on the other hand is largely sugar and although it has the same water content as meat the sugar enables it to keep.

Relating this to starchy staples including breadfruit, cassava, taro and plantain. They are largely made up of starch which interacts with water to a certain degree and will not allow bacteria to grow BUT it will allow yeasts and moulds to grow.

Water removal from food.

Water will only evaporate from the surface of food and only into air that has a lower relative humidity than the available moisture (water activity). So in the early stages of drying normal warm air will be sufficient and water will come away from the surface. But the water in the food has to migrate to the surface before it can evaporate. Therefore drying large chunks of food takes a lot longer than thin slices. Eventually the air that we use for drying must have a relative humidity of below 35%. This is pretty dry and does not occur naturally except in deserts or some of the atoll states near the equator.

It is possible to get the relative humidity down to this level by heating the air. If you think of a volume of air with a relative humidity of about 70% - common in most Pacific nations - we can heat and it will expand, the moisture content stays the same so the relative humidity will drop.

Hence we heat air for drying purposes. But once that air has picked up moisture from the food then it has to be replaced which is why we remove it using a fan.

If you look at a solar dryer then the air is heated by the sun and the racks are at an incline so the warm moist air rises to the high end and escapes – it has to be replaced with low relative humidity from the bottom.

So here are the requirements:

- The food must be reduced preferably down to slices.
- It will have a high level of moisture in it at the beginning so that normal sun dried air will evaporate some of the moisture from the food.

- That air has to be removed once it has picked up moisture
- Hence there has to be a draft.
- Later on that normal sun dried air will no longer be suitable and so we have to heat the air.
- Heating is best done indirectly (copra dryers for coconuts use direct wood drying but the copra becomes smoke-tainted and is ok for subsequent oil extraction but not suitable for food - maybe ok for meat and fish)
- So the design of your dryer must be such that there is no smoke contamination.
- Air can be heated with a clean fuel such as propane (CNG or LPG) but more often in the Pacific with electricity which makes the process expensive.

The choice of drying regime must be left to the operator and the location and whether the cost can be recovered in the final product.

The final moisture content is not easy to determine in the final product but by experience if the slices are **very crisp** then dryness is usually sufficient. BUT if you leave that exposed to air which has a high humidity then it will pick up moisture almost instantly. So this dry material must be kept in moisture-proof container. A plastic bag is usually ok but it cannot be polythene it must be at least 50 micron poly propylene but your supplier will assist you.

Fry Drying

Snack foods keep because they are sliced and immersed in oil at a temperature of about 140^{o}C or 160^{o}C. This is higher than the boiling point of water so water boils off – the familiar sizzle when crisps are fried.

This takes the moisture content down to a level where the product will keep but again has to be packaged in a moisture barrier – again at least 50 micron polypropylene.

About: Professor Richard Beyer

Dr. Richard Beyer is a prominent food technologist in the Pacific and considered a leader in food preservation. He is the author of over 15 commissioned reports relating to income generation and food security for the Pacific region. He has completed a textbook relating to the preservation and processing of root crops, bananas, plantain and breadfruit.

Dr. Beyer is available to consult with anyone interested in learning more about his work and he can be reached via email - richard.beyer1946@gmail.com