Chapter 2

New Concepts

2.1 Aw - Water Activity

All microorganisms need water and the amount of water available to them is defined as water activity. Water activity (Aw) is an indication of how tightly water is "bound" inside of a product. It does not say how much water is there, but how much water is *available* to support the growth of bacteria, yeasts or molds. Adding salt or sugar "binds" some of this free water inside of the product and lowers the amount of available water to bacteria which inhibits their growth. The most practical approach for lowering water activity is drying, although it is a slow process which must be carefully monitored, otherwise it may backfire and ruin the product. A simple scale is used to classify foods by their water activity and it starts at 0 (bone dry) and ends on 1 (pure water).

Water activity (Aw) of some foods	
Pure water	1.00
Fresh meat & fish	0.99
Bread	0.99
Salami	0.87
Aged cheese	0.85
Jams & jellies	0.80
Plum pudding	0.80
Dried fruits	0.60
Biscuits	0.30
Milk powder	0.20
Instant coffee	0.20
Bone dry	0.00

Below certain Aw levels, microbes can not grow.

USDA guidelines state:

"A potentially hazardous food does not include . . . a food with a water activity value of 0.85 or less."

Meats were preserved throughout our history and the technology was based on simple techniques of salting and drying. Both factors contribute to lowering the water activity of the meat. Freshly minced meat possesses a very high water activity level around 0.99, which is a breeding ground for bacteria. Adding salt to meat drops this value immediately to 0.96-0.98 (depending on the amount of salt), and this already creates a hurdle against the growth of bacteria. This may be hard to comprehend as we know that water does not suddenly evaporate when salt is added to meat. Well, this is where the concept of water activity becomes useful.

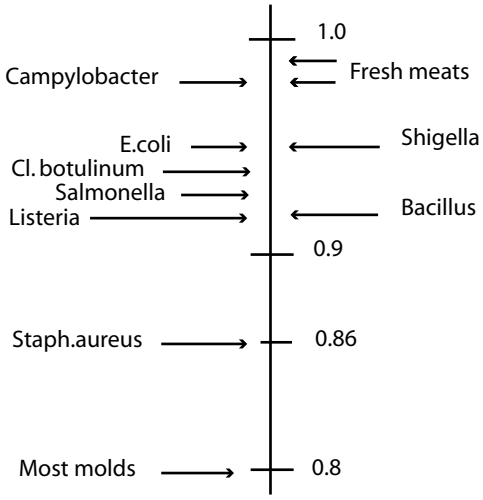
Although the addition of salt to meat does not force water to evaporate, it does something similar: it immobilizes free water and prevents it from reacting with anything else, including bacteria. It is like stealing food from bacteria, the salt locks up the water creating less favorable conditions for bacteria to grow and prosper. As we add more salt, more free water is immobilized but a compromise must be reached, as adding too much salt will make the product unpalatable. It may also impede the growth of friendly bacteria, the ones which work with us to ferment the sausage. The same happens when we freeze meat though we never think of it. Frozen water takes the shape of solid ice crystals and is not free anymore.

The manipulation of water content in processed meat is very important to the successful production of the traditionally made slow-fermented sausages. Water exists in meat as:

- Bound (restricted or immobilized water) - structurally associated with meat proteins, membranes and connective tissues (collagen). This water (3-5% of total water) can only be removed by high heat and is not available for microbial activities.
- Free or bulk water - held only by weak forces such as capillary action. This free water is available for microorganisms for growth.

Removing water content by drying a sausage is a slow process which is not practical when we want to make a product safe to consume within a few days. We could dry sausages at higher temperatures by applying fast air speed, but that would only harden their surfaces, trapping the moisture inside causing the sausages to spoil. Slow, controlled drying is the method applied to traditionally made slow-fermented sausages which require three months or more to produce. As the process proceeds, water starts to evaporate (water activity decreases), making meat stronger against spoilage and pathogenic bacteria. There eventually comes a point, when there are no bacteria present and the meat is microbiologically stable.

It will not spoil, as long as it is kept at low temperatures and at low humidity levels. If the temperature and humidity go up, new bacteria will establish a colony on the surface and will start moving towards the inside of the sausage. The mold immediately appears on the surface.



From the graph on the left it can be seen that except *Staphylococcus aureus*, all other bacteria (spoilage and pathogenic) will not grow below 0.91. This is why drying is such an effective method of preventing bacteria growth and preserving foods in general.

Fig. 2.1 Water activity minimum for growth of microorganisms.

Originally designed for government inspectors, the 4-inch Pawkit is a reliable water activity instrument for use on-the-go. To make a measurement, flip back the sensor cover and fit the Pawkit over a standard AquaLab sample cup. A push of a button brings an accurate reading within five minutes.

Photo courtesy:
Decagon Devices Inc,
Pullman, WA,USA.
www.decagon.com

Photo 2.1 Pawkit water activity meter.