SORENSEN

foodlines

Vol. 3 No. 2, 1982

We never know the worth of water
'til the well is dry.
--Thomas Fuller, Gnomologia

Think Food . . . Think Water . . .

There are only three basic necessities of life: air, water and food, and food itself is largely an energy charged complex of air and water:

Air	carbon, nitrogen	
Water	hydrogen, oxygen	→food
Sunlight	energy	
Soil	traces of minerals	

If essentials can be compared, then water is the most strategic factor in food.

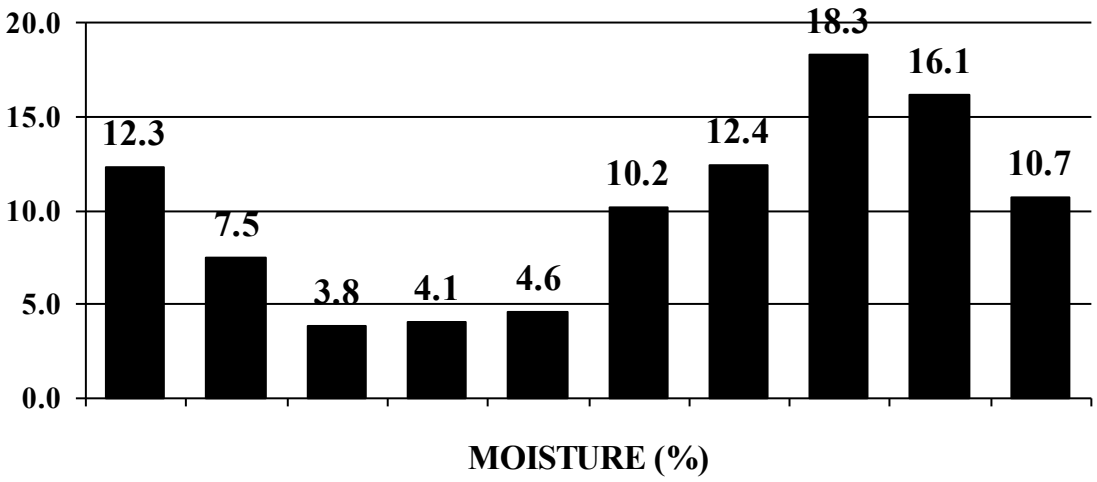
Agriculture and Processing

Roughly three fourths of the earth is covered with water; but only about .5% of this water is fresh. To put this in perspective, consider that, on average, to produce a single pound of food requires 1,000 gallons of water. No wonder then that 80% of U.S. water consumption is for agricultural purposes. The special significance of these observations is that the price and availability of food is obviously related to the price and availability of water. And competing demands for a limited water supply must inevitably result in escalation of water prices. In fact, without profligate government subsidies, agricultural water might easily cost fifty times its current price; with a consequent impact on food prices.

FOOD	GALLONS
Hamburger & Fries	1400
Steak	3500
Chicken	400
Egg	120
Baked Potato	12
Green Beans	18
Salad	6
Bread	26
Butter	100

**Water required to produce one serving*

The accompanying table of water consumption per serving of food produced suggests segments of the food industry that are most at risk from instabilities in the water market. Fortunately, there is ample room for increases in the efficiency of use of water in production of most of these foods. (For example, it is estimated that 50% of all irrigation water is wasted.) Reducing the amount of water required to produce a steak can offset increasing water prices.



Water as an Ingredient

A study of the moisture contents of nearly 2,500 representative foods shows that water is the most common food ingredient. In two out of three foods, water accounts for more than half the food's net weight. The significance of this water is threefold:

- **Economic.** Water is usually the least expensive ingredient in a food. Maximizing moisture minimizes material costs.
- **Customer Acceptance.** Moisture is the basic softening material in food. Consumers usually expect a specific moistness or dryness.
- **Microbiological quality.** Nutrients attractive to people are also attractive to bacteria and other microbes. Controlling moisture, and thereby water activity, can prevent or control microbial growth.

A number of other ingredients are functionally or otherwise closely related to water content: emulsifiers, humectants, gums, stabilizers and some preservatives. No wonder then that in the food industry more quality control effort is directed toward moisture levels than any other single factor. Water technology is a major portion of food technology.

Water and Energy

If water is the strategic material of food, what about the other pivotal factor: energy? Actually they are closely related. First, on a cosmic basis the oceans serve as a massive heat sink for storing solar energy and driving the atmospheric engine of evaporation, cloud convection, condensation, etc. And petroleum is long term storage of solar energy (air + water + soil → petroleum).

On a more local basis, the cost of water is closely related to the cost of the energy required to produce and transport it. This can be relatively low for gravity-fed water of good quality in natural conduits. But purification (desalination, filtration, etc.) and pumping require energy as well as capital investments. In fact, the movement of water whether by pumping or by shipment of moisture laden foods contributes substantially to

the total food bill. Quality factors aside, there is obviously a tradeoff between the energy cost of moisture removal/reconstitution and fuel for shopping. The cost of drying is related to the strong resistance water has to temperature and phase changes. So again, water and energy are related because the higher the moisture level, the greater the energy cost of freezing, canning or other processing that involves substantial temperature changes.

Thinking about food requires thinking about water. Any strategy for the successful management of food necessarily requires a correspondingly successful water strategy. Think food . . . think water!