Refreshment and Thirst Quenching

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March 2, 2009

First, let me clarify that this essay is comprised of conjectures rather then facts or perhaps they may be thought of as hypotheses. Hypotheses that I believe should be tested eventually in the laboratory and in the field. Second, my conjectures are based on my observations and personal reflections related to refreshment and thirst quenching. I will begin with a simple observation: when it is hot in the summer and people are sweaty and thirsty, they will refer to a cold beer as refreshing and especially thirst quenching. Why should a cold beer be any more thirst quenching than an equal volume of warm tap water? Implicit in my question is an assumption that thirst quenching is really about ingesting water or perhaps less specifically liquids. Thirst is the psychological state of wanting to drink liquids. Thus, eating a large bowl of lettuce might eventually terminate one's thirst, but it will not immediately quench one's thirst.

Most commonly when people are thirsty they wish to drink a glass of water. But if sweaty, thirsty people are offered a choice of a glass of warm water versus a glass of cool water, most presumably will choose the glass of cool water. Why this is the case is not immediately clear. They are both equal volumes of water and might be expected to quench thirst equally. So what is the basis of this preference?

To address this question I will draw a parallel to what is known about the relationship of perceived air temperature to the desire to breath. As water deprivation is to thirst, so air deprivation is to the desire to inhale. We can hold our breath longer when our lungs are full then when they are only half full. This is because more air in the lungs allows more oxygen to be supplied to the blood. But it is also true that the larger the inhalation, the colder the pharynx becomes during active inhalation. With each inhalation there is evaporative cooling that causes a noticeable drop in the temperature of the nasopharyngeal and pharyngeal epithelia. Thus, if people inhale cool air versus warm air, they will hold their breath much longer with the lung full of cool air. It appears that a signal of how much air is in the lungs is derived indirectly from the pharyngeal temperature in addition to the actual volume of air. Furthermore, the desire to inhale is not entirely based upon blood oxygenation or CO_2 levels but also upon an unconscious calculation or estimation of how long the air and oxygen supplies in the lungs will last. A similar experiment can be conducted using room temperature air before and after inhalation of menthol vapor. Treatment of the upper airways with menthol allows one to hold the breath longer. The two breaths of air (before and after menthol) are identical in volume and temperature, but the sensation of inhaling after menthol treatment is cooler, which appears to trick the body into believing there is more air present in the lungs. This enables the subject to hold their breath longer, even though the oxygen levels are the same in the two conditions.

Thus if drinking is similar to breathing in these matters, then drinking water is not thirst quenching simply because of the sensation of liquid passing the mouth and throat but also because water placed into the oral cavity that is less than 32°C will feel cool. Hence, cooling during drinking may be an important signal of drinking. Furthermore, if thirst is quenched when water is ingested but prior to its absorption, then the determination that sufficient amounts of water have been ingested to maintain blood volume and osmolarity is a calculation or estimation. Therefore, if cold water gives the sensation that more water is ingested than an equal volume of room temperature water, the cold water will feel more thirst quenching. This may explain why patients in hospitals who are not allowed to drink water may gain some satisfaction of their thirst by sucking on ice chips.

At many bistros and cafes around the world when people order water they are asked if they would like their water still or sparkling (carbonated). I find the general preference for sparkling water to be surprisingly high. Again, why would this be? Carbon dioxide in beverages slightly acidifies oral tissues and is irritating. Could pharyngeal irritation help quench thirst or be more refreshing? The answer is likely related to the reason for preferring cold water. Cold water is slightly irritating (in the extreme case think of eating too much ice cream which causes oral pain) and the sting of CO_2 can enhance sensations of cooling. So the CO_2 may enhance the perception that cold water is consumed, which enhances the perception that water is consumed.

I have also noticed that when people consume cold, carbonated water (and occasionally beer) they often enjoy a twist of citrus fruit, lemon or lime, in their beverage. In addition to making the beverage pleasant smelling, this will add acidity to the water. Could acidic water also be more thirst quenching? If the lower pH contributes to the stings of CO_2 and cold water and enhances the overall sensation of cooling, then it should also enhance thirst quenching. This hypothesis also remains to be tested.

Beer has all of the above mentioned features, but in addition has the important feature of added bitterness from hops. Hop bitters may also contribute to the thirst quenching of beer. The bitterness from hops is unusual in that it tends to be isolated to the pharynx rather than to all the taste receptor fields in the mouth. This distinguishes hop bitterness from most other bitter sensations. Water cools the throat only when swallowing, which gives the pharynx a privileged position for monitoring drinking. This is the same location of the oral cavity where hop bitterness appears. Since we know that there is generally an overlap in bitter and irritating sensations in that they may influence the perception of one another, I believe the pharyngeal bitterness of hops may interact with the irritation of acid, CO_2 and cold water to further increase the pharyngeal sensation of drinking. This hypothesis should be tested as well.

In conclusion, there are several hypotheses above we should test that will clarify the roles of pharyngeal sensations of cold, bitter and irritation on thirst quenching. Our every day behavior suggests that my initial assumption that thirst quenching is merely about liquid ingestion is false. Rather it appears that the physiology of thirst quenching may be similar to our physiology of respiration and the desire to inhale. Cool sensations are complementary signals of the volume of liquid or air passing the entrance ways to the esophagus and trachea. If true, then perhaps beer is ideally suited for thirst quenching due to its combination of cold water, carbonation, slight acidity, and hop extracts.