Taste Profiling

Recent advances in understanding the molecular basis of taste physiology opens new opportunities to optimize in cellular agriculture and food research. This is particularly relevant at a time when alternative ingredients and processing (e.g. 3D printing) are being increasingly used, potentially altering the digestibility and acceptability of alternative diets, even if they are nutritionally balanced. The molecular characterization of taste receptors reveals common taste discrimination mechanisms, common structures within taste groups leading to predictability of a taste profile from metabolite profiling.

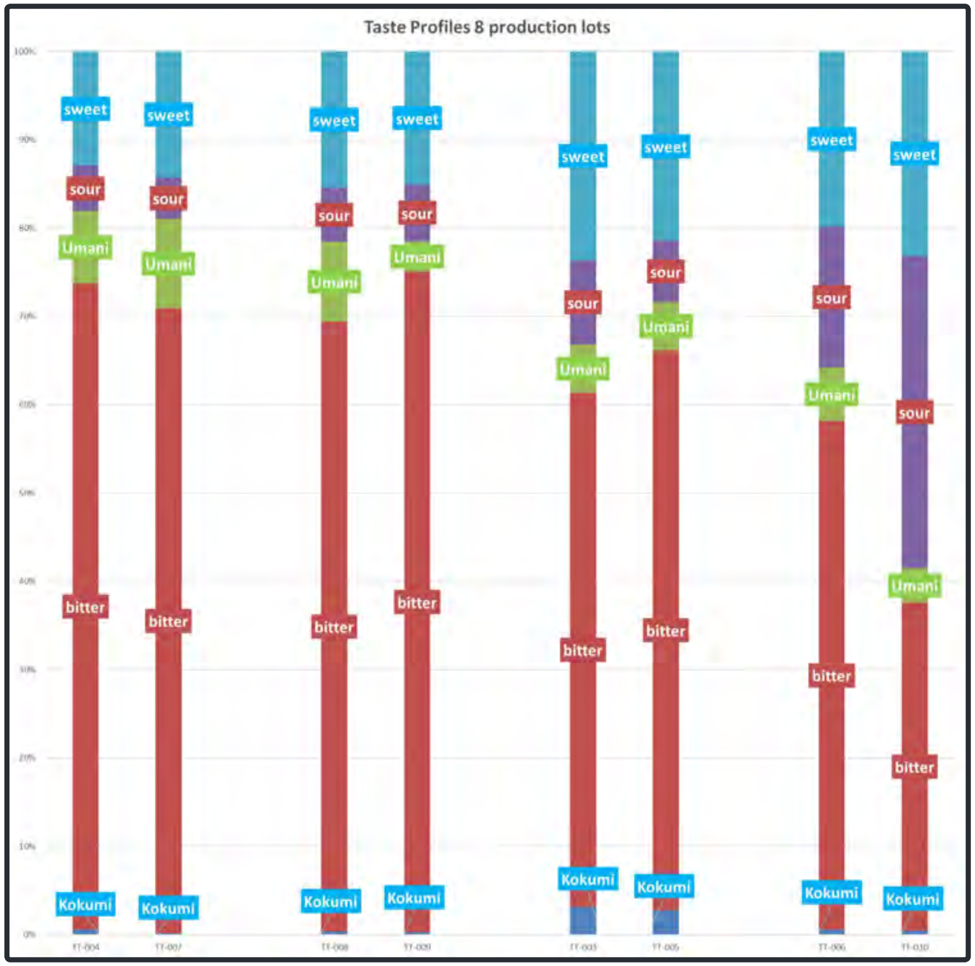
Taste is an important part of our perception of foods. Taste perception in humans is considered to consist of five canonical basic taste qualities: **Sweet, Sour, Salty, Bitter, and Umami**. These 5 basic taste qualities interact in almost every consumed food. The primary function of taste is to identify substances that lead to energy and/or electrolyte balance, while avoiding ingestion of toxic substances. Taste can also serve a metabolic function by preparing the body to assimilate ingested nutrients more effectively. Taste interactions can either be enhancing or suppressing, depending on both the taste quality, specific tastants (those metabolites that enduce a flavor response) and tastant concentrations. These interactions are complex and, even though the interactions between tastes have been extensively researched and reviewed, the mechanisms are still not well understood. However, we continue to learn more about tastants and how changes in a tastant profile lends to changes in food flavor.

Skeletal muscle metabolites found in beef, chicken and fish include amino acids and sugars that are precursors of volatile compounds associated with aroma. Muscle metabolites are useful indices to predict or evaluate meat flavor and overall palatability. Metabolic profile comparisons between meats of different animal breeds, feeding conditions, and cellular processes can indicate changes in taste profiles. Studies reveal that metabolomic information is expected to provide indices to predict sensory phenotypes of meat.

Taste Receptors

Bitter, sweet, and umami receptors are well understood. The receptors for each of these taste qualities are, by and large, restricted to a single cell types within the taste bud, allowing encoding of information by activation of unique populations of cells. One misconception is that taste receptors are only in the taste buds in the oral cavity. In fact, taste receptors are distributed throughout the body from the nasal cavity to the intestines.

Taste signals are mediated by distinct transduction pathways expressed in subsets of taste receptor cells. Specifically, sweet and umami tastes are detected by the G protein-coupled receptor (GPCR), T1R family. Umami is detected by metabotropic glutamate receptors. Bitter taste, on the other hand, is detected by GPCR T2R family. Sour and salty tastes are modulated by specialized membrane channels. For sour taste, acid sensing ion channels and for salty taste, epithelial sodium channel facilitates its detection. The out puts of these taste receptors include ATP and neurotransmission through the gustatory nerves.



OLEOGUSTUS, OILY OR FATTY TASTE

Lipid sensors have been identified on the tongue which suggests that fat can be considered as the sixth taste. People can identify the distinct taste of fat as something totally separate from its texture. While the pure flavor of fat might sound delicious, it’s not. Oleogustus is described as “unpalatable,” “rancid” and “irritating.” when it’s tasted on its own. However, combined with other flavors, oleogustus can be delicious. Fatty taste itself is not pleasant. When concentrations of fatty acids are high in a food it is typically rejected, as would be the case when a food is rancid. Long chain nonesterified fatty acids (LC-NEFA) are proposed as stimuli for "fat taste". While shorter chain fatty acids (2 to 5 carbons) stimulate a sensation similar to sour and middle chain fats (6 to 12 carbons) to provide a more complex flavor. In general, as chain length increases to long chain (13 to 21 Carbons) this sensation changes to an oleogustus taste.

KOKUMI TASTE

Kokumi is another putative taste quality gaining interest in the field of sensory sciences. Kokumi is a well-accepted taste sensation in Asian cuisine. It is described as a sensation of enhancement of sweet, salty and umami tastes when associated with specific compounds

The human Calcium Sensing Receptor (CaSR) has been designated as the putative kokumi taste receptor for humans. CaSR is a member of the same receptor class as the T1R receptors for umami and sweet taste, the class C of GPCRs. CaSR has been found to be expressed in most tissues involved in calcium homeostasis e.g. the parathyroid glands, kidneys, thyroid and the brain, as well as the gastrointestinal tract and taste papillae. It is also known to be involved in many physiological processes including, gastric acid secretion, insulin release from beta-cells in the pancreas and promoting glucose tolerance, as well as, pathophysiological processes such as vascular calcification and osteoporosis.

γ-glutamyl peptides have been identified as a primary tastant for Kokumi and for agonist activity against hCaSR. Like Umami, kokumi is an important taste modality for carnivores that enhances the palatability of meat-derived compounds such as peptides and amino acids.

STARCHINESS OR STARCHY TASTE

It is widely accepted that humans can taste mono- and disaccharides as sweet substances, but they cannot taste longer chain oligo- and polysaccharides. From the evolutionary standpoint, the ability to taste starch or its oligomeric hydrolysis products would be highly adaptive, given their high nutritional value. Glucose oligomer detection (7 to 14 glucose units) is found to be independent of the T1R2/ T1R3 sweet taste receptor. Because starch is one of the primary sources of energy that enables the body to perform its function, its gustatory detection would be highly beneficial. Large glucose oligomers and polymers (e.g. starch) can be detected through the gustatory system, independent of the sweet taste, when starch is broken down into smaller glucose oligomers by an enzyme in our saliva called alpha-amylase. These smaller glucose oligomers can be tasted by specific receptors. The taste of these glucose oligomers is cereal-like, bread-like or rice-like and generally referred to as “starchy”.