Carolina™ Taste Papers

Information

Testing the ability to taste phenylthiocarbamide (PTC) has been a mainstay activity in human genetics for generations of teachers and students. The ability to taste PTC is inherited. Traditionally this is presented as a case of simple Mendelian inheritance involving a dominant allele for tasting and a recessive allele for nontasting of PTC. However, it has long been recognized that PTC tasting is not an either/or trait. There is great variability in the taste threshold: the concentration at which a given person can taste PTC. In other words, a student who is scored as a nontaster when tested with our PTC Taste Paper might be scored as a taster if presented with a higher concentration of PTC.

The main PTC gene locus is on human chromosome 7. Currently there are two predominant, widely distributed forms or alleles of the gene and several less-frequent haplotypes. The predominant alleles are AVI and PAV. AAV is a less frequent, less well-defined allele, and there are others of more restricted distribution. PAV probably corresponds closely to the traditional dominant allele for PTC tasting and AVI (somewhat less closely) to the traditional recessive allele. Students who have two copies of PAV will find that PTC Taste Paper is extremely bitter. Students with one copy of PAV will likely report a bitter taste but may not react as strongly. Students with two copies of AVI will score as nontasters of PTC. However, the rare student who has inherited AVI and AAV may or may not have some ability to taste PTC. A further complication is that these PTC alleles are estimated to explain 60–70% of the observed variability in PTC tasting. There are reports of other gene loci, on other chromosomes, that also influence the ability to taste PTC. This is an area of active research, so our understanding of the genetics of PTC tasting is likely to continue changing.

Because the concentration of PTC in our Taste Paper is extremely low, it is likely that only those students with a high sensitivity to PTC will be able to taste it. Students who definitely report a bitter, unpleasant taste should be scored as tasters. Students who report tasting nothing other than the paper or who are uncertain should be scored as nontasters. When interpreted in this way, about 70% of students tested will be tasters and 30% will be nontasters of PTC. The values obtained from a given class may show variation from these percentages due to the small size of the sample.

Interpreting the results of PTC tasting in terms of genetics is less clear cut. It is likely that most of the students who score as tasters with our Taste Paper carry at least one copy of PAV. It is also likely that the nontasters carry two copies of AVI or (much less likely) one copy of AVI and one copy of AAV.

Many have wondered if the PTC alleles have been subject to selection pressures during human evolution. PTC has an N–C=S group that is thought to be associated with its bitter taste. It shares this group with some other bitter tasting compounds, including thiocynate compounds that are widely found in broccoli, cauliflower, and other members of the mustard family. Food preference studies show that PTC tasters tend to avoid these vegetables and other strongly flavored foods. Nontasters tend to eat a more varied diet that includes green leafy vegetables. The thiocynates found in plants of the mustard family inhibit thyroid function, so the ability to taste and reject these compounds might offer protection against thyroid disorders. Others have pointed out that plant poisons are often bitter; thus, the ability to taste bitter substances might be important in hunter-gatherer societies. It may be that genetic drift and founder effect have been more important in the distribution of the PTC alleles. All three alleles are found in European populations. AAV is uncommon in Asia, and Native Americans carry the PAV allele almost exclusively. The greatest variation in the PTC alleles is found in African populations. This is consistent with founder populations moving out of Africa into Europe and Asia, and a later movement from Asia to the Americas.

Many other substances chemically closely related to PTC evoke taste responses. Among these are thiourea (thiocarbamide) and sodium benzoate. Many will report a very bitter or even nauseating taste response to thiourea. Sodium benzoate is widely used as a food preservative. The most common taste reactions to sodium benzoate are: sweet, salty, bitter and no taste. An interesting question for students to explore is whether there is any correlation between the ability to taste PTC and taste responses to these other substances. For example, it has been claimed that a nontaster of PTC will never report a bitter taste response to sodium benzoate.

RN-17-4000	Control Paper
RN-17-4010	PTC Paper
RN-17-4020	Sodium Benzoate Paper
RN-17-4030	Thiourea Paper

Further Reading

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