Examining the Genetics of PTC Sensitivity[1] and Tongue Rolling

Part I – PTC Inheritance

Do you like the taste of broccoli? Some people like its taste, but it tastes bitter to others. One reason why people perceive bitter tastes differently is that they have different forms of taste receptors on their tongues.

A synthetic substance called **phenylthiocarbamide (PTC)** is one of the molecules some people perceive as **tasting bitter**. Paper coated with PTC tastes bitter to some people but is almost tasteless to others. The ability to taste PTC correlates with the ability to taste some bitter foods such as broccoli. PTC-like chemicals are found in the Brassica family of vegetables, such as cabbage, brussels sprouts, and broccoli. People who can taste PTC often do not enjoy eating these vegetables, since they taste bitter to them. Non-tasters tend not to notice bitter tastes and therefore may be more likely to become addicted to nicotine (which is bitter).

In non-African individuals, approximately 75% of people can taste PTC while the remaining cannot.

The **ability to taste PTC** seems to be **genetically inherited**. To determine the type of inheritance of PTC tasting, a scientist by the name of L. H. Snyder determined the PTC phenotypes for the members of 100 nuclear families. He first verified that gender was not a factor by comparing the number of male tasters and non-tasters to the number of female tasters and non-tasters. Because there was essentially no difference between sexes, Snyder grouped families by the phenotypes of the parents, disregarding the gender of each parent, and tabulated his data (Snyder, 1931)[2]:

Parent-Phenotype Combinations	*No. of families*	*Phenotypes of Children*	
		Can taste	*Cannot taste*
Both parents can taste	40	90	16
One parent can taste, the other cannot	51	80	37
Neither parent can taste	9	0	17

Questions

1. What kind of evidence would indicate that the ability to taste PTC is inherited?
2. Why was it important for Snyder to verify that males and females had similar proportions of tasters and non-tasters?
3. Why do couples who can taste PTC have children who cannot?
4. What is the significance of the fact that couples who cannot taste PTC, *never* have children who can?
5. Based on these data, what can you conclude about PTC taste blindness? What is your evidence?

Part II – Tasting PTC

Your instructor will provide 2 strips of paper to each student: one strip with PTC on it, while the other serving as a control. Taste both strips and note whether you can taste PTC

1. Based on your phenotype, can you determine your genotype?
2. Does the phenotypic ratio of the class reflect that found in non-African populations? How confident are you about your answer? Perform a statistical analysis (use Excel) that would allow you to determine the level of confidence of your answer.

[1] Adapted from a case study by the same title written by R. Deborah Overath (Department of Life Sciences Texas A&M University – Corpus Christi)

[2] Snyder, L. H. 1931. Inherited taste deficiency. *Science* 74: 151–152.

Part III – Genetics of Tongue Rolling

In 1940, the famous geneticist Alfred Sturtevant noted that about 70% of people of European ancestry are able to roll up the lateral edges of the tongue, while the remaining 30% were unable to do so. Tongue rolling ability may be due to a single gene with the ability to roll the tongue a dominant trait and the lack of tongue rolling ability a recessive trait. [3]

1. Determine your phenotype and possible genotype for tongue rolling.
2. Does the phenotypic ratio of the class reflect that found in European populations? How confident are you about your answer?
3. Alexander cannot roll his tongue and is unable to taste PTC, while Natasha is both a PTC taster and tongue roller. Natasha's father is a PTC taster but cannot roll his tongue, while her mother cannot taste PTC but is a tongue roller. Alexander and Natasha are married and are planning on having a baby. What are the chances that their first child will be a PTC taster, tongue non-roller girl?

Part IV – Population Genetics of PTC Tasting

You may recall that the ability to taste PTC shows dominant inheritance and is controlled by a gene on chromosomes 7. This gene codes for part of the bitter taste receptor in tongue cells. One of its five alleles causes a lack of ability to sense bitter tastes; the other 4 alleles produce intermediate to fully sensitive taste abilities. Approximately 75% of people can taste PTC while the remaining 25% cannot.

PTC-like chemicals are found in the Brassica family of vegetables, such as cabbage, Brussels sprouts, and broccoli. People who can taste PTC often do not enjoy eating these vegetables, since they taste bitter to them. Non-tasters tend not to notice bitter tastes and therefore may be more likely to become addicted to nicotine (which is bitter).

Class data on PTC tasting were collected from 3 NYA classes. The following results were obtained: 97 tasters and 45 non-tasters.

1- What is the frequency of the allele that causes lack of ability to taste PTC in the class population, assuming the population is in Hardy-Weinberg equilibrium?

2- If the class population is in Hardy-Weinberg equilibrium, how many individuals are expected to be heterozygous for PTC tasting?

[3] The Basics and Beyond: An Introduction to Heredity. Available at http://learn.genetics.utah.edu.