Investigating Inheritance Patterns of PTC
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Introduction

I chose to focus my second personal inquiry on genetics and inheritance patterns. Gregor Mendel, who is now considered the father of modern genetics, discovered the principles of modern genetics while working in his garden. He was the first to propose that factors influencing heredity were passed on directly from parent to offspring as opposed to the blending of parental features (Openstax, 2013). Mendel's law of dominance states that in a heterozygote, the dominant allele will always be fully expressed. The recessive allele will remain dormant in a sense, but can be passed on to offspring. The recessive trait will only be visible when offspring carry two copies of this allele (Openstax, 2013).

For this inquiry I investigated how a bitterness receptor gene which allows the taste of phenylthiocarbamide (PTC) is inherited in my family. Variation to PTC sensitivity was first noticed in the early 1930s, when a laboratory "incident" produced a white cloud of PTC and one researcher complained about a bitter taste while an OSHA officer insisted he could taste nothing (Wooding, 2006). Research indicates that PTC sensitivity inheritance follows Mendel's law of dominance, with individuals carrying the dominant allele being able to taste PTC (National Human Genome Research Institute, n.d.). Individuals who do not carry a dominant allele will not be able to taste PTC, regardless of age, sex, or ethnicity (Wooding, 2006).

Methods

Experimental preparation

A PTC tasting kit was obtained commercially which contained strips of paper soaked in PTC as well as inert control paper strips. Both strips were white, but control strips were slightly longer to ensure samples did not get mixed up during testing.

Taste tests and data collection

Test subjects were first asked to place the control strip of paper into their mouth. A reaction should not be observed. Next, the subject was asked to place the PTC paper into their mouth. Subjects were recorded as "taster" if they grimaced or described being able to taste a bitter substance, or as "non-taster" if they could not taste anything. This information was used to then interpret respective genotypes.

Results & Interpretations

A total of nine subjects, including my husband and myself, our parents, and our siblings were tested for the ability to detect PTC. Five subjects could detect PTC and four subjects, including myself, could not (Figure 1).

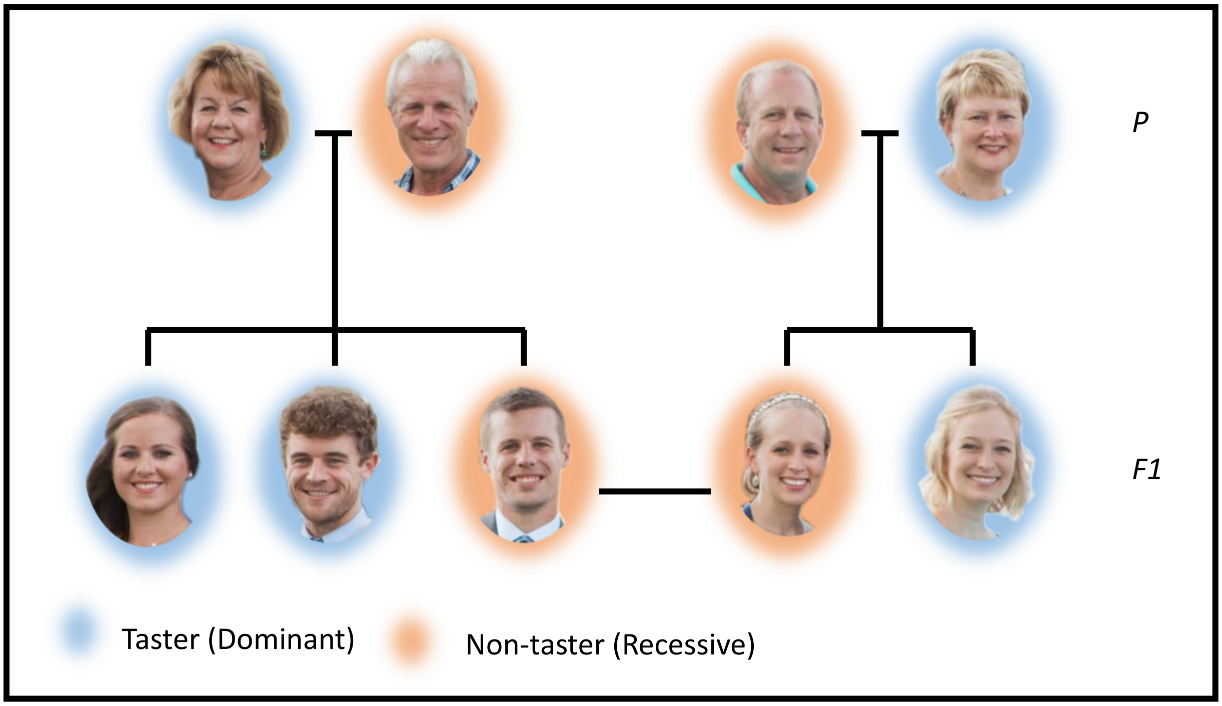

Figure 1. PTC tasting ability in two generations.

Genotypes were determined using Punnett squares and deductive reasoning based on Mendel's law of dominance (data not show). Four subjects tested were non-tasters, thus carrying a homozygous recessive genotype (pp). Five subjects tested were tasters, meaning their genotype could be either homozygous dominant (PP) or heterozygous dominant (Pp). Given the presence of non-tasters in the F1 generation, who must receive a recessive allele from each parent, it can be deduced that all tasters must be heterozygous dominant (Pp) (Figure 2).

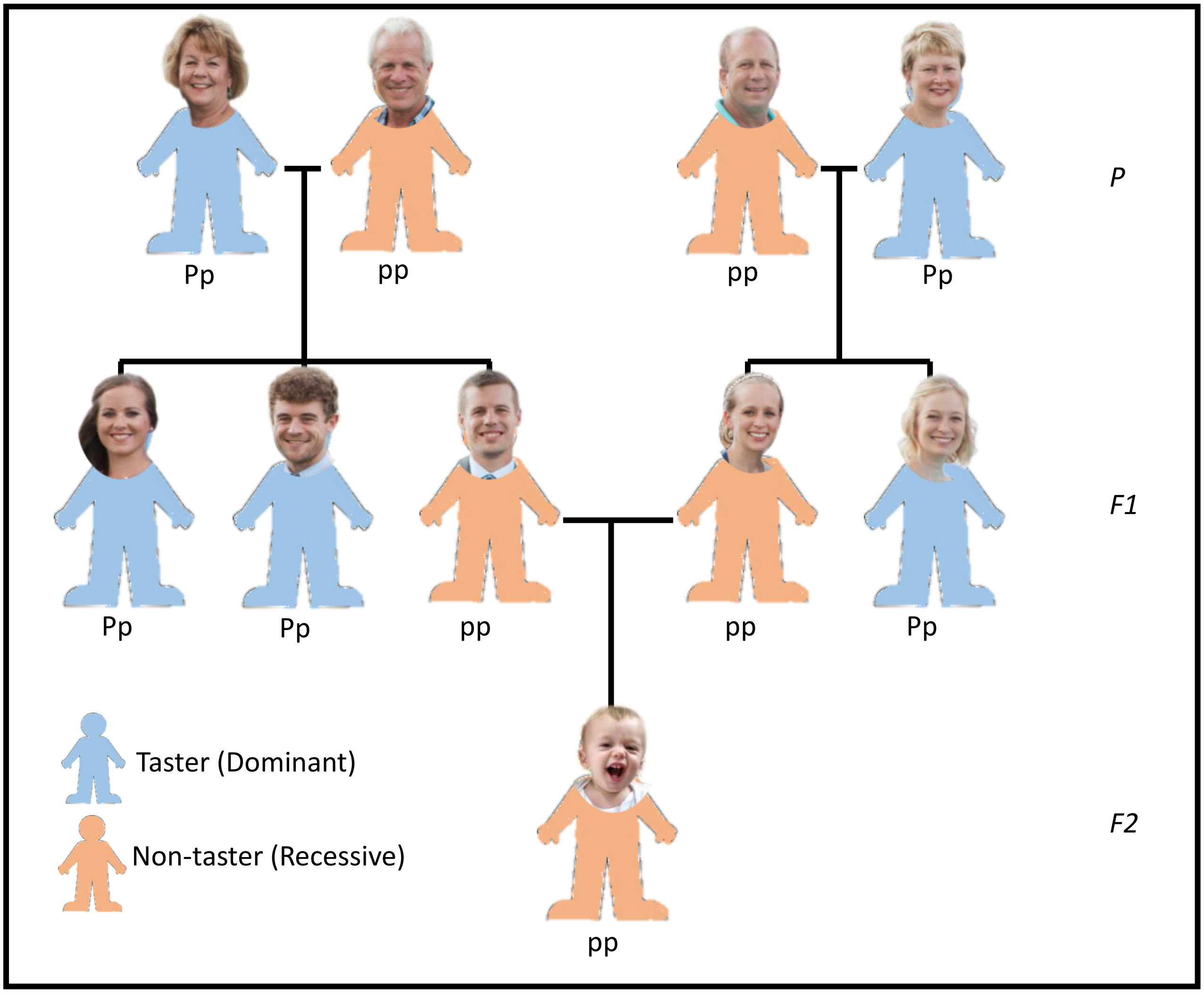

Figure 2. Genotypes of PTC tasters and non-tasters.

The ability to identify both my husband and myself as non-tasters (homozygous recessive) allowed me to also be able to assign a phenotype and genotype to our son. He must also be a non-taster, as it is only possible for him to receive recessive alleles from both parents (Figure 2). All potential offspring that my husband and I will produce will be homozygous recessive non-tasters.

Discussion

I really enjoyed completing this inquiry; it was particularly interesting to map out how a particular trait is expressed across my family. The frequencies for this inquiry were 50% dominant, and 50% recessive. This distribution is slightly skewed from anticipated frequencies given by Mendel's law of dominance (75% dominant, 25% recessive), but results align with previously reported frequencies in population genetic studies (Wooding, 2006). It has been suggested that the ability to detect PTC and other bitter compounds could have been naturally selected for, as it would be advantageous for our ancestors to be able to detect bitter alkaloid compounds found in many plants (National Human Genome Research Institute, n.d.; Wooding, 2006). If this were fully true, however, all non-tasters would have died off and the recessive allele would have lost in the gene pool. It is believed by some that those individuals unable to taste PTC can taste other bitter compounds (University of Utah Health Sciences, 2016). If this is true, heterozygotes able to taste both PTC and other bitter compounds would yield the greatest selective advantage.

If I were to repeat this experiment I would create a questionnaire to issue alongside the PTC taste test. It would include a list of food and beverages and will assess taste preferences for PTC tasters versus non-tasters. Previous research has shown that PTC tasters are less likely to drink tea and coffee, and less likely to consume dark chocolate, grapefruit and bitter greens like broccoli (National Human Genome Research Institute, n.d). Given that I work at a brewery in the evenings, I also wonder if beer preference is influenced by the PTC gene or not. Specifically, are PTC tasters less likely to drink pale ales and hop-heavy beers? My husband and I are both non-tasters and we both prefer to drink pale ales and India pale ales (IPAs). It would be interesting to see if these trends hold true for my family.

Literature Cited

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