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A Study on Phenylthiocarbamide Tasting in Bagatha Tribes in India

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Abstract

Anthropometric characters have been used for racial classification for so many years. However, the use of Genetic characters offers the special advantage of helping to understand the dynamics of human populations. Genetic traits with variable frequency in different populations are useful in evaluating and analyzing evolutionary forces, as well as for classification of human race. For understanding the human diversity many polymorphic genetic markers have been used. The present study shows the variation among the taste sensitivity to Phenylthiocarbamide (PTC) and colourblindness in Bagatha tribal population of Visakhapatnam district.

Keywords: Bagathas, PTC, colorblindness, genetic variation, gene frequency.

Introduction

The sex-linked deficiency of color-vision occupied a eminent position in the study of human variation. The trait is inherited as X-linked recessive characters males being effected more than females. This defect is said to be partial. On the contrary, the total color-blind people cannot recognize these colors at all. The defect and its sub types can be detected by using Ishihara plates. A great number of reports appeared in the scientific literature suggesting differential incidence in various populations which favours as an anthropological marker.

Another such genetic trait is the inherited inability to taste an organic compound, phenylthiocarbamide (PTC). Phenylthiocarbamide (PTC) is also known as Phenylthiourea (PTU) is an organosulfururthiourea containing a phenyl ring. It has an unusual property that either very bitter or is virtually tasteless, depending on the presence of the gene. The people who can taste it are having a dominant genetic trait and the test to determine PTC sensitivity is one of the most commonly used genetic tests on humans. PTC also inhibits melanogenesis and is used to grow transparent fish[1]. About 70% of the people can taste PTC[2]. It was found that non-smokers and those not habituated to coffee or tea have a statistically higher percentage of tasting PTC than the general population[3-5]. The genetic correlation was so strong that it was used in paternity tests before the advent of DNA matching[6]. There is a large body of evidence linking the ability to taste thiourea compounds and dietary habits. Much of this work has focused on 6-propyl-2-thiouracil (PROP), a compound related to PTC that has lower toxicity[7]. A supertaster has more of an ability to taste PTC. On the other hand, heavy cigarette smokers are more likely to have high PTC and PROP thresholds (i.e. are relatively insensitive). Ability to taste PTC may be correlated with a dislike of plants in the Brassica genus, presumably due to chemical similarities[8].

There are three SNPs (single nucleotide polymorphisms) along the gene that may render its proteins unresponsive[9]. There is conflicting evidence as to whether the inheritance of this trait is dominant or incomplete dominant. Any person with a single functional copy of this gene can make the protein and is sensitive to PTC. Some studies have shown that homozygous tasters experience a more intense bitterness than people that are heterozygous; other studies have indicated that another gene may determine taste sensitivity. The frequencies of PTC taster and non-taster allele vary in different human populations[10].

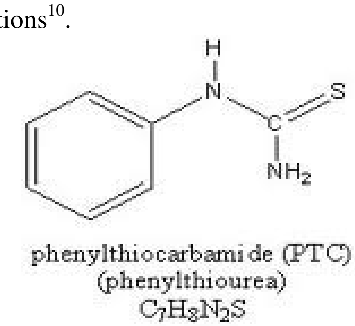

Figure-1
PTC structure C_7HgN^2S

The testing of PTC is also called as PTC tasting, a genetically controlled ability to taste phenylthiocarbamide (PTC) and a number of related substances, all of which have some antithyroid activity. PTC-tasting ability is a simple genetic trait governed by a pair of alleles, dominant *T* for tasting and recessive *t* for nontasting[11]. Persons with genotypes *TT* and *Tt* are tasters, and persons with genotype *tt* are nontasters; there appears to be hormonal mediation of the tasting ability, women are more often taste-sensitive in this regard than are men. It has been suggested that PTC tasting may be related to the genetically determined level of dithiotyrosine in the saliva[12].

PTC-tasting ability is not particularly useful, since PTC does not occur in food, but some substances related to PTC do occur in food items[13]. As for the utility of being able to taste PTC, it appears that nontasters of PTC may have a higher than average rate of goitre, a disease of the thyroid gland sometimes associated with a lack of iodine; because PTC and related compounds contain iodine, there may be a selective advantage of some kind for tasters or nontasters in different environments[14]. It has also been suggested that tasters may have more food aversions than nontasters, a disadvantage in situations of food scarcity. The chief reason for interest in tasting ability, however, is that the frequency of tasters varies from population to population.

Variation in PTC sensitivity was first discovered by chemist named Arthur Fox in the early 1931s. A large number of people found that distinct variation was common regardless of age, sex, and ethnicity[15]. It was found that most people fall into two categories: the people who can taste the compound even at very low concentrations are called as tasters and those who are unable to taste even at high concentrations are called non tasters or taste blind people[16].

The ability to taste PTC (or not) is conveyed by a single gene that codes for a taste receptor on the tongue. The PTC gene, TAS2R38, was discovered in 2003. There are two common forms (or alleles) of the PTC gene, and at least five rare forms[18]. One of the common forms is a tasting allele, and the other is a non-tasting allele[19]. Each allele codes for a bitter taste receptor protein with a slightly different shape[20]. The shape of the receptor protein determines how strongly it can bind to PTC. Since all people have two copies of every gene, combinations of the bitter taste gene variants determine whether someone finds PTC intensely bitter, somewhat bitter, or without taste at all.

The Bagathas are also called as Bhaktas or Baktas. They account for their name by the tradition on that they served with great devotion. They are a class of Telugu fresh water fisherman and expert as catching fish with a long spear. They make a small margin of profit by means experting tamarind and cutting wood[21]. They are broadly classified into three sub groups. That is pedal, kakari and ulangi. The people speak mainly Orea but they can also speak telugu and other languages. Rice is the staple food besides this other grains lie sama, chodi and maize are also consumed along with rice[22]. They are having their own festivals and rituals.

Material and Methods

200 samples were collected from bagata population for taste sensitivity with different concentrations and color blindness. Only unrelated subjects aged from various age groups were tasted. For color blindness the educated people used 1-24 plates to read the numbers and uneducated people used 25-38 plates is based on the unwinding lines by tracing them. Depending on these it can identify whether the person is colorblind or not.

PTC Testing: To determine the PTC taste is a very process and very simple. It is one of the common and most genetic tests that can be done by human. The serial dilution was prepared from the stock solution of 1.0 grams of PTC dissolved in one litre of distilled water at below 600C by constant stirring. It was marked No:1, which was again added to equal quantity of distilled water by thorough shaking to make a uniform concentration of next higher number. 14 solutions have been prepared in the same manner. Each person was tasted from low concentration to higher concentration of the solute to remove the fatigue. Otherwise a small piece of chemically coated paper was given to the subject. They will place that on their tongue and taste it.

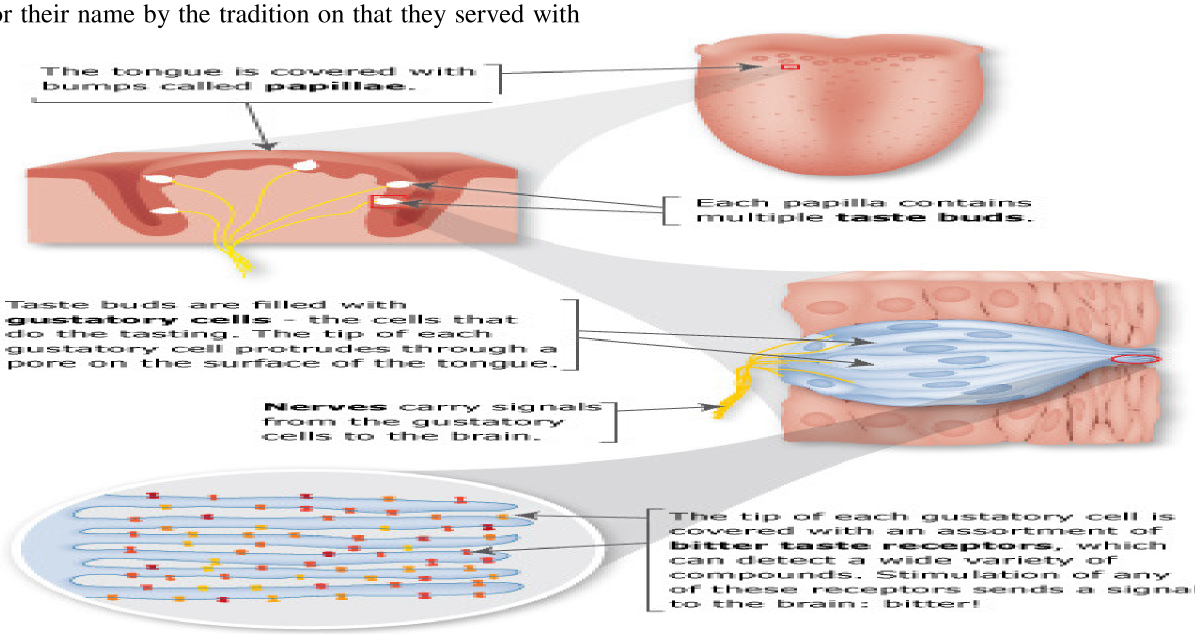

Figure-2
Tongue shows the bitter taste receptors

Figure-3
PTC Testing papers

Based on the variation in PTC tasting in various populations the heteroxzygotes have a selective advantage than homozygotes. One hypothesis, however, is that genotype at the PTC locus may influence food selection through its effects on bitter taste sensitivity. Given that bitterness is associated with toxic compounds, PTC tasters may be more likely to avoid such toxic compounds while PTC nontasters might be willing to eat a broader variety of foods These differences in food selection of bitter tasting foods may, in turn, influence metabolism and physiology.

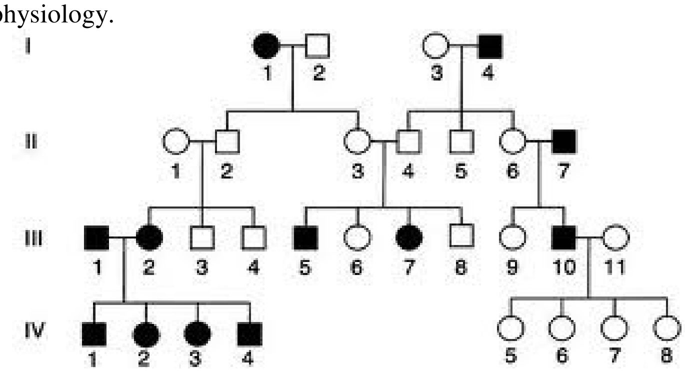

Figure-4
Pedigree of PTC Testing

Results and Discussion

All males and female individuals are normal in their population and hence the frequency of the gene for colorblindness is 0% and the frequency of the gene for normal vision is 1% (p=1%) and (q=0%) p is normal allele and q is the abnormal allele. In PTC testing the distribution of tasters in Bagathas is bimodal. The antimode value of males is at threshold 4 and females were at 5. The distribution of threshold values in age group of 10 years in males 0.0681 and in females it is 0.0654. The frequencies of taster and non-taster phenotypes and the gene frequencies for each sex separately. There is a slight difference in gene frequencies of the two sexes. The chi square values expected and observed are a good fit with Hardy-Weinberg principle of genetic equilibrium. The phenotype frequency of males tasters were 68.63% and non-tasters were 31.37%. In females the tasters % was 62.24 and non-tasters % was 37.76.So the frequency of taster gene 0.654 and non-taster gene is 35.56.

The habit of beedi chewing was fond to be prevalent in 85% of the males and where as in females it was only 4%. So the habit may not interfere with age changes or threshold value consistently.

Conclusion

The testing of PTC is a fundamental tool in fields as diverse as genetics, psychophysiology, ecology, evolution, nutrition, and even science education. The role of this trait on natural selection, and design of the test for the effects of natural selection in a specific human gene, is testament to the fundamental importance of the trait in allowing us to understand the origins of genetic variation in humans.

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