European Science Methodical Journal
ISSN (E): 2938-3641
Volume 3, Issue 4, April- 2025

GENETIC STUDY OF THE TASTE OF PHENYLTHIOCARBAMIDE (PTC) TRAIT IN WASIT PROVINCE POPULATION

Firas Rahi Alhachami 1,
Jinan Tuma Sabah 2
1 Department of Biology, College of Education for Pure Science,
Wasit University, Wasit, Iraq.
2 Department of Pathological Analysis, Faculty of Sciences,
University of Wasit, Wasit, Iraq.
Corresponding authors: fhandhal@uowasit.edu.iq , Jtuma@uowasit.edu.iq

Abstract:

The taste of PTC substance is one of the human traits that distinguishes people into tasters and non-tasters, controlled by a single gene (TAS2R38). The current study aimed to determine the genetic distribution of this trait in the community of Wasit Governorate, Iraq, and whether there is a deviation from the normal proportions of the trait. A sample of 500 students of both sexes from Wasit University students, aged between 19-25, were subjected to examination using PTC strips. The study showed that the number of tasters exceeds the number of non-tasters (345 and 155, respectively), and that females are more than males, with a significant difference (p.0.374). the homozygotes recessive (tt) which represented as q and dominants homozygote was represented as p in Hardy Weinberg equilibrium, and the allele frequency of q (t) was 0.211 and p (T) was 0.330 and according to Hardy Weinberg equilibrium, the heterozygotes are represented by the 2pq were (0.480).

Keywords: Taste of Phenylthiocarbamide, human traits, single gene (TAS2R38).

Introduction

The ability to taste the bitterness of phenylthiocarbamide (PTC) is one of the important threshold characters in humans that has received the attention of researchers in the past and present, as it is considered one of the genetic markers used in anthropological studies of human evolution, adaptation to its environment, immunity against some diseases, and nutritional behavior (1).

PTC is a substance that inhibits the activity of the thyroid gland and causes its enlargement (goiter). It is also an inhibitor of the activity of the enzymes Phenol oxidase and Tyrosinase, and an inhibitor of the discoloration of insects and plants. It is also an anti-oxidant substance. In addition, some derivatives of this substance have anti-ulcer activity (2). In *in vitro* experiments, it was found that this substance has a role in inhibiting the growth of cancer cells (3). When this substance is dissolved in water, it produces a solution that some individuals can sense a bitter taste, while others cannot distinguish this taste. This sensory taste represents a case of genetic polymorphism (4). It was found that individuals who are unable to taste PTC are also characterized by an inability to taste the bitterness of other similar chemicals that have the N - C = S bond, especially the compound 6-n-pro-polythiouracil (5, 6).

Most sources indicate that the ability to taste PTC is a simple Mendelian genetic trait that is transmitted from parents to children via a single gene that has a pair of alleles, one of which is dominant (T) and the other is recessive (t) (complete dominance), meaning that there are three genotypes and two phenotypes for the taste trait of this substance, Tt and TT for taste and tt for non-taste (7). It has been observed that tasters show differences in their sensitivity to taste PTC, as some individuals are more sensitive to taste this substance (Super taster) and are believed to be of the genotype (TT) than others who are medium taster and are believed to be of the genotype (Tt) (8), while others have indicated that it is a trait with incomplete dominance, or that it is under the control of multiple genes (9, 10).

Recent genetic studies using DNA sequencing technology have revealed the presence of a major site (TAS2R38) that controls the taste of this substance, located on the long arm of the seventh chromosome 7p15. It was found that the products of the T and t alleles are a protein composed of a long chain of amino acids amounting to (333) amino acids, and they are very similar in the sequence of these acids except for the difference in the locations of three amino acids, where the PAV pattern (proline, alanine, valine) indicates tasters, while the AVI pattern (alanine, valine, isoleucine) indicates non-tasters. Some other changes were found in different peoples and human clans at the molecular level and the DNA sequence (Table 1).

Despite the importance of studying human genetics, the researches in this field have remained few and limited in our Arab world in general and in Iraq in particular. The current study aimed to investigate the genetic polymorphisms of the ability to taste phenylthiocarbamide among random sample of Wasit University students.

Table 1. Difference of three amino acid and its phenotypes (7).

Allele	PAV	AVI	AAV	AAI	PVI
Phenotype	Super-Taster	Medium- taster	Non- taster	Unknown	Unknown

1. Material and methods

This study was conducted on a random sample of Wasit University students, which included 500 students, aged between 19 and 25 years, all of them were in good health and did not suffer from any genetic diseases or health problems, especially in the mouth, that could affect the ability to taste the PTC. Information was taken from all participants in the study regarding age, gender, diet, blood group, weight and medical history.

The Phenylthiocarbamide test paper, which comes in vials of 100 genetics testing strips (45 mm length by 3 mm broad), PL Precision Laboratories in the USA, was used. The participant were requested to rinse their mouth twice and then put the PTC strip on their tongues and saturate it with saliva and then describing how they felt about the PTC strip.

The square expansion of the allele frequencies was used to get the genotype frequencies. Assuming that the locus for taster T has two alleles, T and t, we assume that the frequencies of alleles T and t are p and q, respectively. The Hardy-Weinberg equation states that the frequencies are represented as follows: f (T) = p and f (t) = q. The genotype frequency according to Hardy-Weinberg law were p2+2pq+q2=1, whereas the allele frequency was p+q=1.

2. Result and discussion

Out of 500 participants in the study, 243 were males and 257 were females. There were 345 tasters (69%) and 155 non-tasters (31%); 190 (73. %) and 67 (26%) of the females were tasters and non-tasters, respectively, and 155 (63%) and 88 (36%) of the males were tasters and non-tasters, respectively. According to the findings, there was a significant gender difference with a higher percentage of tasters among females than among males (P=0.374) and vice versa among non-tasters (P=0.465) (Table 2).

Table 2. The percentages of tasters and non-tasters for males and females.

Gender (no.)	**The phenotype**	
	Tasters	Non- tasters
	No. (%)	No. (%)
Male (243)	155 (63)	88 (36)
Female (257)	190 (73)	67 (26)
***P* value**	0.374	0.465

Data analysis according to the Hard-Weinberg law showed that the dominant allele (T) appeared at a higher frequency than the recessive allele (t) in the entire sample and among males and females, as shown in Table 3.

Table 3. Frequency of alleles for the taste trait of the PTC gene according to the Hardy-Weinberg law.

Gender	**Sample size**	**TT**	**Tt**	**tt**
Female	257	0.220	0.500	0.224
male	243	0.299	0.490	0.190
total	500	0.330	0.480	0.211

The current study, which was conducted on a random sample of students at Wasit University in Wasit Governorate, showed that the number of tasters (345, 69%) is more than the number of non-tasters (155, 31%), and it was in accordance with Mendel's law for traits controlled by a single gene. These results are in line with previous results about the increase in the number of tasters by a percentage of 3 tasters: 1 non-tasters, and the percentage of tasters in Wasit Governorate was greater than the percentage of tasters in other studied Iraqi governorates (11) as a result of Wasit Governorate lacking ethnic and national diversity and including one electoral area, as living beings in different places are exposed to different electoral environments and pressures (3).

The study showed the effect of gender on the ability to taste the bitter taste of PTC, as the percentage of female tasters was more than the percentage of non-tasters (73%) and (63%), respectively. the percentage of female non-tasters was less than the percentage of male non-tasters (26%) and (36%),respectively with significant differences ($p \leq 0.05$). These results are consistent with previous studies that confirmed that the taste of this substance is affected by gender, with females having a greater taste (12, 13).

The frequency of genotypes in the studied sample according to the Hardy-Weinberg equilibrium is that the heterogeneous genotype (Tt) showed a higher frequency than the homogeneous genotypes (TT, tt) in both males and females and the entire sample (0.500, 0.490 and 0.480), respectively. Some research indicates that natural selection may play an important role in the development of this trait and that the variation in the phenotype is the result of parallel natural selection that tends to select for heterozygote genotype (14).

3. Conclusion

The study concluded that natural selection plays an important role in maintaining a balanced picture of taste (T) and non-taste (t) alleles in the Arab society. This gives wide importance to the recognition of bitter toxic substances through taste, which helps in survival. Despite the great development in molecular genetic techniques, the mechanism by which the alleles of this trait work is still not determined. The study suggests that the alleles controlling the taste of PTC have a role in building one of the types of sensory receptors, and that the quantitative variation in the sensitivity of tasting this substance is due to the variation in the number of these receptors or their efficiency in interacting with the substance PTC.

References

1. Drewnowski ‹A.; Henderson ‹S.A. and Barratt-fornell ‹A. (2001). “Genetic Taste makers and food preferences" .American Socie. Pharm. & Experi. Therapeutics; 29 (4) : 535-538 .
2. Merritt ‹R.B.; Bier wert ‹L.A.; Slatko ‹B.;Weiner ‹M.; Lngram ‹J. Sciarra ‹K. and Weiner ‹ E. (2008)"Tasting phenylthiocarbamide (PTC): Anew Integrative genetics lab. With an old flavor". Am. Bio. Teacher ‹on line Publication. P:23-28
3. Akella ‹G.D.; Henders ‹SA. and Drewnowski ‹A.(1998)"Sensor acceptance of Japanes green tea and soy products : a linked to genetic sensitivity to 6-N-Propythiouracil" Nutr. Cancer ‹29:146-151.

4. Blakeslee ‹A.F. and Fox ‹A.L. (1932)." Our different taste worlds: PTC as a demonstration of genetic differences in taste ". J. Hered. ‹23 : 96 -107 .
5. Barnicot ‹N.A.; Harris ‹H. and Kalmus ‹H. (1951).”Taste thresholds of further eighteen Compounds and their Correlation with P.T.C. thresholds". Ann. Eugene lond. 16(2): 119-128.
6. Fischer ‹R. (1967). "In the chemical Senses and Nutrition". (Kare ‹M. and Mallero ‹ O.Eds). Johns Hopkins univ Press ‹Baltimore ‹pp: 61-81.
7. Kim ‹U.K.; Breslin ‹P.A.S.; Reed ‹D. and Drayna ‹D. (2004)"Genetics of Human Taste perception". J. Den. Res. 83: 448-453. www.genetics.utah.2002, university of Utah.
8. Bartoshuk, L.M.; Duffy, V.B. and Miller I.J. (1994). "PTC/PROP tasting, Anatomy, Psychophysics and Sex effects" Physiol, Bchav , 56: 1165 1171 .
9. Olson ‹J.M. ‹Bochnke ‹M. ‹Nelswanger ‹K. ‹Roch ‹A.F. and Siervogel ‹R.M. (1989)"Alternative genetic models for the inheritance of the phenylthiocarbamide taste deficiency". Genet. Epidem. 6:423-434.
10. Reddy ‹B.M. and Rao ‹D.C. (1989)" phenylthiocarbamide taste sensitivity revisited: complete sorting test supports residual family resemblance". Genet. Epidem. 6:413-421.
11. Shihab ‹A.F. and Asady ‹A.A.B. (1993) ." Taste ability to phenylthiocarbamide (PTC) in the Population of Basrah ". Accepted for publishing in Basrah J. Sci.
12. AL-Rubeai ‹M.A.F. (1975) ." Taste sensitivity to phenylthiocarbamide and blood groups in the Iraqi Population (sample from Baghdad) ". Bull. Coll. Sci. ‹16(2) : 205 – 215 .
13. AL-Ani ‹B.A. and Abdullah ‹N.F. (1999) ." Association between PTC tasting and specific Population characteristics in Iraq" . Ibn AL-Haitham J. Pure App. Sci. ‹11(2) : 23 -32.
14. Malini ‹S.S.; Ramegowds ‹S. and Ramachandra ‹N.B. (2007)"Evolution of phenylthiocarbamide taster trait in My sore ‹south India". Ind. J. Hum. Gene. 13(1): 16-20.