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DISTRIBUTION AND FREQUENCY OF PHENYLTHIOCARBAMIDE (PTC) TASTER AND NON-TASTER ALLELES IN THE THARU POPULATION OF LAKHIMPUR KHERI-U.P. INDIA

OM PRAKASH SINGH*

Department of Zoology, Yuveraj Dutta PG College Lakhimpur Kheri -262701, India

ABSTRACT

Phenylthiocarbamide's bitter taste is a genetically determined trait. The taste perception ratio and gene frequency of phenylthiocarbamide tasters compared to non-tasters are variable traits in different human populations. Several studies have reported that around 65-70% of human populations are tasters and 30–35% are non-tasters. Overall, a total of 841 Tharu tribes (506 males and 335 females) from Lakhimpur residing along the Nepal border were used for this study. The frequency of non-tasters was 25.1% and the "t" allele frequency was 0.50, while the frequency of tasters was observed to be 74.9% and the "T" allele frequency was 0.50. There was an observable but statistically insignificant (p 0.05) difference in the PTC taste sensitivity. There is limited information on the population genetics of the Tharu population of Lakhimpur Kheri district regarding taste perception. This study investigated the distribution and frequency of taster (T) and non-taster (t) alleles in the Tharu population using phenylthiocarbamide (PTC % composition is 30 mcg/taste strip). The present study was carried out to analyse the predominance of PTC taste sensitivity and allelic frequencies among the Tharu tribes of Lakhimpur Kheri.

Key words: Gene frequency, human population, phenylthiocarbamide, taste sensitivity, tharu tribe.

INTRODUCTION

Today it has been well established that the ability to taste PTC exhibits a clearcut monohybrid pattern of inheritance (Mohr, 1951: Das, 1956). The importance of the ability to taste phenyl thiocarbamide (PTC) was realized by Fox (1932). Thereafter, Snyder (1934) showed that the inheritance of the ability to taste PTC was dependent on a single autosomal dominant gene. Those who can taste the chemical are either homozygous dominant (TT) or heterozygous (Tt) whereas the non-tasters are always recessive homozygous (tt).

Studies in human population genetics have been under taken by several investigators and genetic variability can be quantified by determining the frequencies of alleles at segregating loci. The important information concerning mutation, selection, random genetic drift, inbreeding, protein polymorphism and association between genetic markers and diseases in different regions of the world have been obtained (Cavalli-Sforza, 1973,1998; Penrose,1975).

Although anthropologists have reported the distribution of PTC tasters and non-tasters in some Indian populations, they have not elucidated the allelic frequencies of the genes determining this trait. The number of tasters and non-tasters has been analysed in different Indian populations (Tiwari and Bhasin, 1967; Mahapatra and Das, 1968; Mitter and Bansal, 1975; Reddy, 1983). Bhalla (1972) studied Tibetan and Ladakh populations for PTC sensitivity and frequency. He observed that more than 50 percent of the people in this area could taste this chemical. The analysis and distribution of allelic frequency of some genetically determined traits were observed in human populations in eastern Uttar Pradesh (Singh and Singh, 2004; 2006). Marriages between the two separate castes in this part of Uttar Pradesh are a rare phenomenon. It was quite unfortunate that the Tharu tribes residing in Lakhimpur Kheri district, part of north-eastern Uttar Pradesh, could not be involved in this kind of study. People inhabiting this part are divided into various castes and thus form separate populations.

The aim of the present study is to analyse the allelic frequency of PTC taster in the tharu population of Kheri district of Uttar Pradesh, and the data obtained have also been compared for the distribution and allelic frequencies of this trait with the populations of other regions of the country.

MATERIALS AND METHODS

PTC sensitivity is often used as an example of a simple Mendelian trait with dominant inheritance. However, tasters vary greatly in their sensitivity to PTC. The PTC gene has about 85% of the total influence over whether someone is a taster or a non-taster. There are many other things that affect PTC's tasting ability. Some people may find that they can taste PTC on some days but not on others. Having a dry mouth may make it more difficult to taste PTC. What the subject ate or drank before sampling PTC paper may also affect their tasting ability.

Both sexes belonging to the Tharu tribe population of Lakhimpur Kheri district of Uttar Pradesh were observed for phenyl thiocarbamide tasting. This ability to taste is a genetically determined character and shows a monohybrid pattern of inheritance. The gene determining this trait is autosomal and located on chromosome 7q, major locus on 7q35-q36 and secondary locus on chromosome 16p. The gene encodes belongs to TAS2R family. Phenylthiocarbamide paper (30 mcg/taste strip) was used for scoring the tasters and non-tasters. Along with tharu tribe villagers, tharu students studying at Yuveraj Dutta PG College were also selected for this study.

Some persons detect a bitter taste of this chemical (PTC). The bitter taste is due to the presence of NC=S group in the compound. Persons who could taste the chemical were genetically dominant either homozygous (TT) or heterozygous (Tt) while the non-taster were recessive homozygous (tt).

The method employed to find out the allelic frequency of T and t was as follows –

$$frequency\ of\ recessive\ allele\ = \sqrt{\frac{No.of\ persons\ with\ recessive\ phenotype}{Total\ number\ of\ \ persons\ analysed}}$$

The frequency of dominant allele (T) = 1– t (Strickberger, 1990).

➡ PTC paper used to test whether a person is taster or non-taster

Today we know that 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.

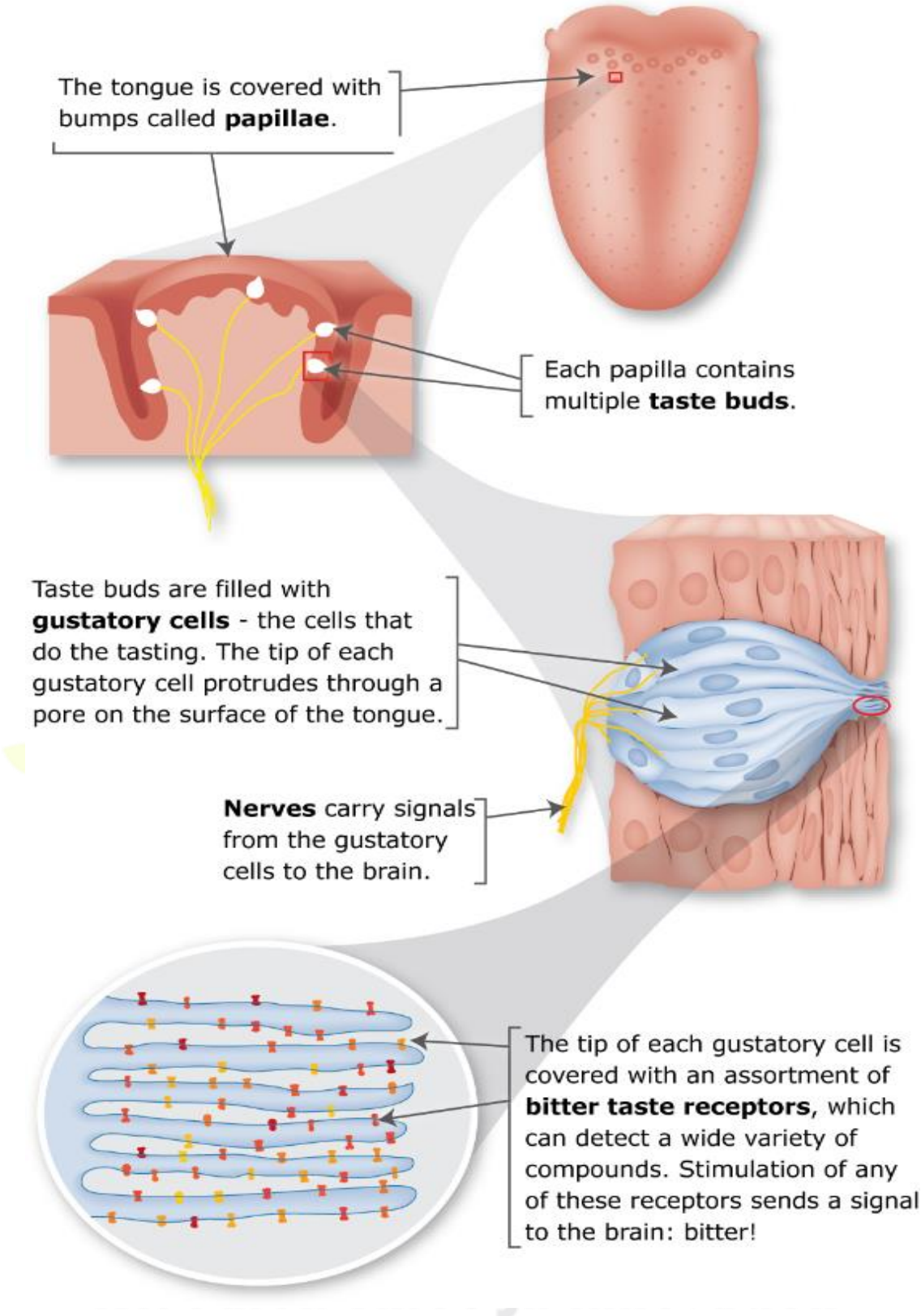

Fig. 1- Courtesy- School of Medicine, University of Utah.

There are two common alleles of the PTC gene, and at least five rare forms. One of the common forms is a tasting allele, and the other is a non-tasting allele. Each allele codes for a bitter taste receptor protein with a slightly different shape. 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.

RESULTS

Phenylthiocarbamide is a chemical that tastes bitter. The heritability of this trait and its precise mode of inheritance are determinable from family studies. Table 1 shows the number and percentage of male and female phenylthiocarbamide tasters and non-tasters and their gene frequency in the Tharu tribes of Lakhimpur Kheri. In this population, the number of tasters was considerably higher than that of non-tasters. The data of the tharu population shown in the table were analysed and showed that 77.5 percent of males and 71.1 percent of females were tasters, while 22.5 percent of males and 28.9 percent of females were non-tasters. Males showed more tasting ability than females. Fig 2 shows the frequency of dominant allele T was higher in males (0.53) than in females (0.46) and the frequency of recessive allele t was higher in females (0.54) than in males (0.47). The frequency of both the alleles was observed to be equal or close to equal in male and female tharu tribes of Lakhimpur Kheri, which is due to the higher number of heterozygotes in the taster group. The gene frequency in the combined population of both sexes shows equal value.

Table 1: Number and percentage of PTC tasters and non-tasters in tharu tribes of Lakhimpur Kheri district

Tharu Population	No. of Persons Analysed	PTC		Allelic Frequency	
		Tasters	Non-tasters	T	t
Male	506	392	114	0.53	0.47
		(77.5)	(22.5)		
Female	335	238	97	0.46	0.54
		(71.1)	(28.9)		
Total	841	630	211	0.50	0.50
		(74.9)	(25.1)		

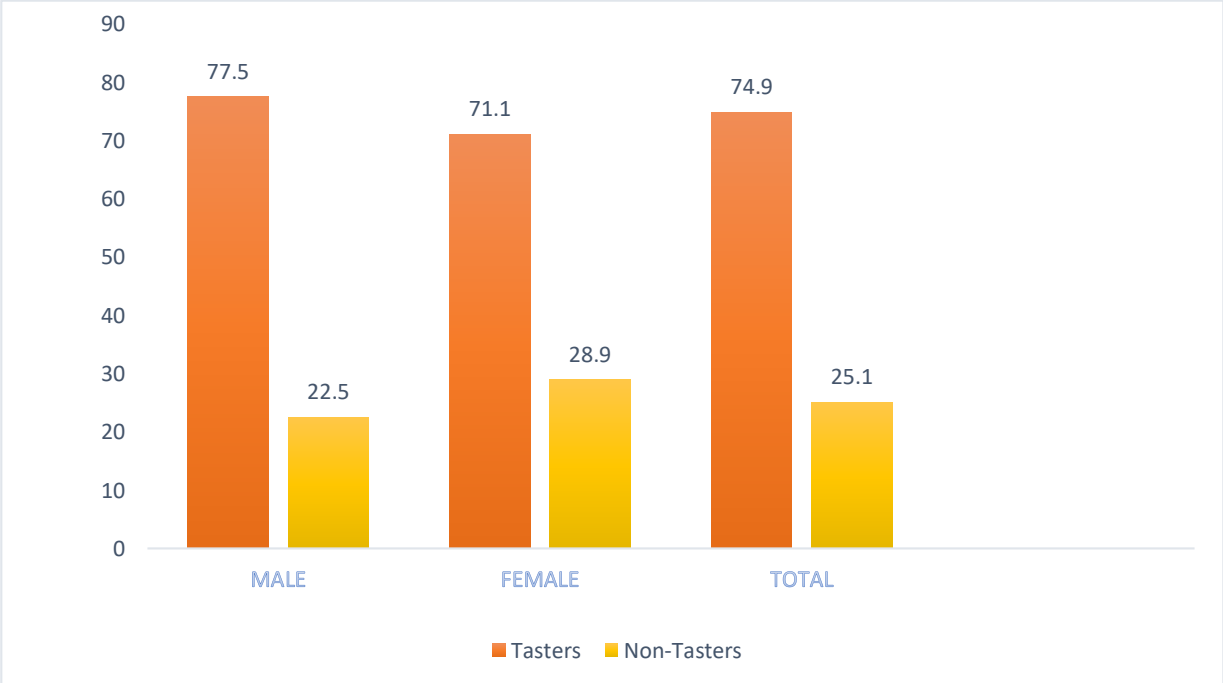

Fig. 2: Diagram showing percentage of 'T' and 't' alleles in male and female population of tharu tribes of Lakhimpur Kheri district.

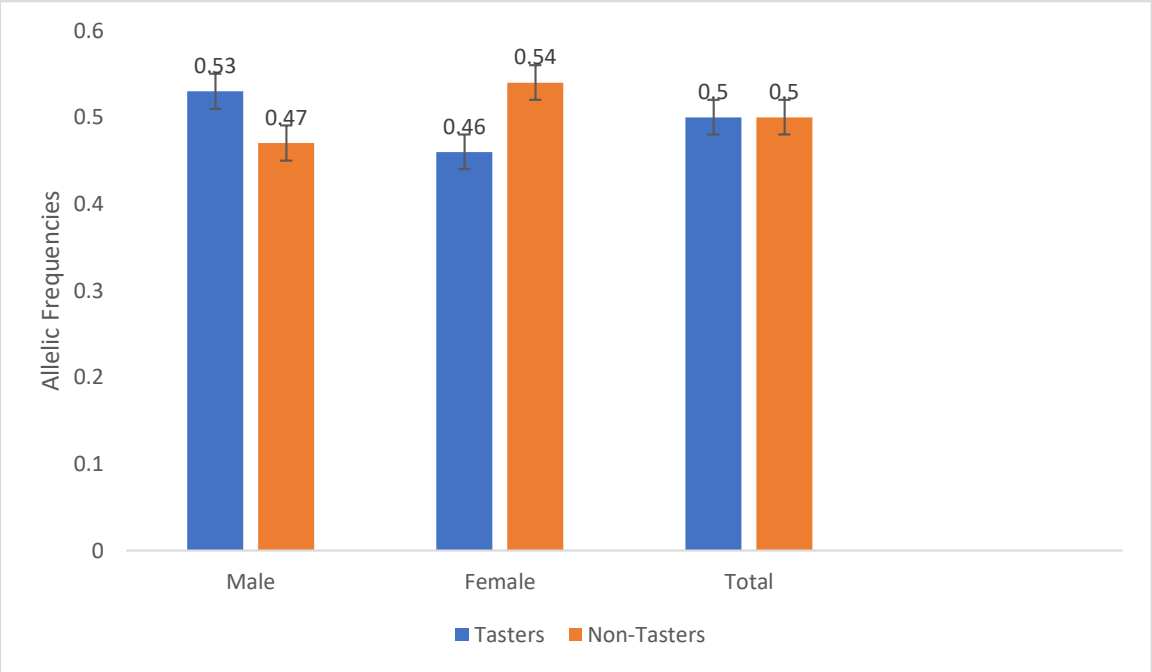

Fig. 3: Diagram showing frequency of 'T' and 't' alleles in male and female population of tharu tribes of Lakhimpur Kheri district.

DISCUSSION

Phenyl thiocarbamide (PTC) tasters and non-tasters were distributed in the tharu population studied. In males, the number of tasters (77.5 percent) was observed in the tharu population from Lakhimpur Kheri, where the frequency of the T allele was (0.53), and in females, it was (71.1 percent), and the frequency of the T allele was (0.46). In males, the number of non-tasters was (22.5 percent), and the frequency of the recessive allele 't' was (0.47), while in females, the non-tasters were (28.9 percent), and the frequency of the "t' allele was (0.54). The combined frequency of 'T' and 't' in males and females was (0.50).

Among different castes of Hindus and Muslims from five districts of eastern Uttar Pradesh, the frequency of T allele ranged from 0.37 to 0.68 and the recessive allele t ranged from 0.32 to 0.63 (Singh and Singh 2011). People of eastern U.P. shows higher range of fluctuation of T allele (0.37 to 0.68) as compared to the results from North India and European populations.

A very low frequency of 'T' allele (0.10) has been observed in Munda populations of Ranchi (Shukla and Tyagi, 1975) and 0.16 in Pahira population of Singhbhumi (Basu 1969).

The frequency of taster 'T' is about 0.50 among European populations (Kitchin et.al. 1959). Mongoloid populations of East Asia and South East Asia shows 0.55 to 0.95 frequency of 'T' allele (Harris and Kalmus, 1949; Harris et.al. 1949). The frequency of T allele varies from 0.59 to 0.67 among Tibetan populations of North India (Tiwari, 1966; Sharma, 1967; Bhalla 1972). Bhalla et.al. (1980) reported high frequency of 'T' allele in Western Himalayan regions. High frequency of this allele was also recorded by Ranganayaki and Injeti (1979) from Visakhapatnam; Kumar and Narhari (1987) from Andhra Pradesh. Bangham and Howarth (1980) analysed frequency of 'T' allele in different populations residing Indo-Nepal border.

The present study shows frequencies of dominant and recessive alleles of the PTC gene in the tharu population of Lakhimpur Kheri. The number of tasters are considerably higher than non-tasters in the tharu population. The frequency of both the alleles approaches to equal due to tasters with heterozygous genotype.

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