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ALLELIC FREQUENCY OF PHENYLTHIOCARBAMIDE TASTERS AND NON-TASTERS IN DIFFERENT HUMAN POPULATIONS OF EASTERN UTTAR PRADESH

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ABSTRACT

Phenylthiocarbamide (PTC) chemical tastes bitter and its tasting is a genetically determined trait. People with PTC tasting ability are dominant for this trait while those who can not taste this chemical are recessive for the character. Seven human populations from five districts of eastern Uttar Pradesh were analyzed for the distribution of tasters and non tasters for PTC chemical. The frequency of dominant and recessive alleles of this gene was also calculated. In all the populations the tasters were much higher in number than non-tasters. The frequency of T allele is higher than t in most of populations except schedule caste population. The allelic frequency of T ranged from 0.37 to 0.68 whereas the frequency of recessive allele ranged from 0.32 to 0.63. The frequencies of dominant and recessive alleles are almost equal in Hindus and Muslims.

KEY WORDS: Allelic frequency, Phenylthiocarbamide, Tasters and non-tasters

Genetic variability is a feature of many populations of animals and plants. This variability can be quantified by determining the frequencies of alleles at segregating loci. Studies in human population genetics have been under taken by several investigators and 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).

The importance of the ability to taste phenylthiocarbamide (PTC) was realized by Fox (1932). Thereafter, Synder (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 or heterozygous where as the non tasters are always recessive homozygous. Today it has been well established that the ability to taste PTC exhibits a clear cut monohybrid pattern of inheritance (Mohr, 1951; Das, 1956).

The number of taster and non-tasters have been analysed in different Indian populations (Tiwari and Bhasin,1967: Mahapatra and Das, 1968; Mitter and Bansal, 1975: Reddy,1983). Bhalla (1972) studied Tibet and Ladakh populations for PTC sensitivity and its frequency. He observed that more than 50 percent people of this area could taste this chemical. Although anthropologists have reported the distribution of PTC tasters and non-tasters in some Indian populations but they did not elucidate the allelic frequencies of gene determining this trait. It was quite unfortunate that people of eastern U.P. could not be involved for this kind of study. Recently we have started the analysis and distribution of allelic frequency of some genetically determined traits of human populations of eastern UP (Singh and Singh, 2004, 2006). People inhabiting this part are divided into various castes and thus form separate populations. Marriages between the two separate castes in this part of Uttar Pradesh are a rare phenomenon. The aim of the present study is to analyze the allelic frequency of PTC tasters in different populations of five districts of eastern U.P. Hindus and Muslim populations have also been compared for the distribution and the allelic frequencies of this trait.

MATERIALS AND METHODS

Subjects (both sexes) belonging to different populations (castes) of five districts of eastern Uttar Pradesh were observed for phenylthiocarbamide tasting. PTC tasting is a genetically determined character and shows monohybrid pattern of inheritance. The gene determining this trait is autosomal and located on 3rd chromosome. Phenylthiocarbamide papers (blotting paper soaked in 0.05 PTC solutions) were used for scoring the tasters and non-tasters.

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

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

Frequency of recessive allele (t) =

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

The frequency of dominan allele (T)1 t (Strickberger,1990).

RESULTS

Phenylthiocarbamide (PTC) is a chemical which 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 phenylthiocarbamide tasters and non-tasters and their allelic frequency in different populations from Sultanpur district. In all the populations the numbers of tasters are considerably higher than non-tasters. However the frequency of dominant and recessive alleles was observed equal or close to equal in five populations which is due to more number of heterozygotes in the tasters group. Frequency of 't' is higher than 'T' only in Kayastha and schedule caste populations.

Table 2 embodies data of the different populations from Pratapgarh district. Here 72.7 percent Hindus and 78.5 percent Muslims show PTC tasting ability. Allelic frequency of 'T' was higher in Muslims (0.54) than Hindus (0.48). The number of tasters were more in all the populations analysed. Kashatriya showed highest frequency of T allele. Table 3 shows tasters and non-tasters from Jaunpur districts in which Hindus and Muslims showed 78.0 percent and 78.9 percent PTC tasting ability. In this region maximum frequency of 't' was observed in schedule caste and minimum frequency of 't' was recorded in Kshatriya population.

The data of persons with PTC traits from Faizabad district is shown in table 4. 80 percent people from this district in different castes were analysed as tasters. Two populations i.e. kashatriya and OBC showed highest frequency of T allele. Table 5 presents data from Ambedkar Nagar populations, where frequency of 'T' allele in different populations ranges from 0.43 to 0.55, being lowest in Kshatriya and highest in Hindus. Table 6 shows summary of allelic frequencies of 'T' and 't' alleles in seven populations of five districts of eastern Uttar Pradesh. The frequency of 'T' allele ranges from 0.47 to 0.55 in Brahmins ; 0.43 to 0.68 in Kshatriya ; 0.48 to 0.61 in OBC ; 0.37 to 0.50 in SC ; 0.38 to 0.55 in Kayastha ; 0.44 to 0.55 in Muslims and 0.48 to 0.55 in Hindus.

DISCUSSION

Phenylthiocarbamide (PTC) tasters and nontasters were distributed in all the populations studied. The frequency of T allele ranged from 0.37 to 0.68 and the recessive allele t ranged from 0.32 to 0.63. Hindus and Muslims from Sultanpur, Jaunpur and Faizabad districts showed equal frequency of T allele. However, people of these two communities studied from Ambedkar Nagar and Pratapgarh districts showed much difference. The minimum numbers of tasters (60.9 percent) were observed in schedule caste people from Pratapgarh where frequency of T allele was 0.37. Maximum percentage (89.7) of tasters was recorded in Kshatriya populations from Sultanpur where the frequency of T allele was 0.68.

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.

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 present study presents the frequencies of dominant and recessive alleles of the PTC gene in different populations of Uttar Pradesh in much exhaustive form, for the first time. Most interestingly, the numbers of tasters are considerably higher than non-tasters in all the populations of five districts. The frequency of both the alleles approaches to equal in several populations due to tasters with heterozygous genotype. Further the comparative analysis between combined populations of Hindus and Muslims reveal that except for Pratapgarh and Ambedkar nagar districts the two populations show equal distribution of T and t allele. People of eastern U.P. show higher range of fluctuation of T allele (0.37 to 0.68) as compared to the results from North India and European populations.

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Table 1 : Number and percentage of PTC tasters and Non - tasters and frequency of T and t allele in different populations of Sultanpur District

Populations	Total No. of Persons analysed	PTC		Allelic Frequency	
		Tasters	Non - tasters	T	t
Brahmins	302	228 (75.5)	74 (24.5)	0.50	0.50
Kshatriya	204	183 (89.7)	21 (10.3)	0.68	0.32
OBC	304	205 (67.4)	99 (32.6)	0.52	0.48
SC	50	31 (62.0)	19 (38.0)	0.43	0.57
Kayastha	60	46 (76.7)	14 (23.3)	0.38	0.62
Muslims	528	397 (75.2)	131 (24.8)	0.50	0.50
Hindus	920	693 (75.3)	227 (24.7)	0.50	0.50

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Table 2 : Number and percentage of PTC tasters and Non -tasters and frequency of T and t allele in different pop ulations of Pratapgarh District

Populations	Total No. of persons analysed	PTC		Allelic Frequency	
		Tasters	Non - tasters	T	t
Brahmins	282	225	57	0.55	0.45
		(79.8)	(20.2)		
Kshatriya	232	198	34	0.62	0.38
		(85.3)	(14.7)		
OBC	302	221	81	0.48	0.52
		(73.2)	(26.8)		
SC	87	53	34	0.37	0.63
		(60.9)	(39.1)		
Kayastha	104	80	24	0.52	0.48
		(76.9)	(23.1)		
Muslims	317	249	68	0.54	0.46
		(78.5)	(21.5)		
Hindus	1109	806	303	0.48	0.52
		(72.7)	(27.3)		

Table 3 : Number and percentage of PTC tasters and Non - tasters and frequency of T and t allele in different populations of Jaunpur District

Populations	Total No. of persons analysed	PTC		Allelic Frequency	
		Tasters	Non - tasters	T	t
Brahmins	206	159	47	0.52	0.48
		(77.2)	(22.8)		
Kshatriya	188	162	26	0.63	0.37
		(86.2)	(13.8)		
OBC	256	191	65	0.50	0.50
		(74.6)	(25.4)		
SC	106	69	37	0.41	0.59
		(65.1)	(34.9)		
Kayastha	83	64	19	0.52	0.48
		(77.1)	(22.9)		
Muslims	289	228	61	0.54	0.46
		(78.9)	(21.1)		
Hindus	948	739	209	0.53	0.47
		(78.0)	(22.0)		

Table 4 : Number and percentage of PTC tasters and Non - tasters and frequency of T and t allele in different populations of Faizabad District

Populations	Total No. of persons analysed	PTC		Allelic Frequency	
		Tasters	Non - tasters	T	t
Brahmins	260	204 (78.5)	56 (21.5)	0.54	0.46
Kshatriya	232	198 (85.3)	34 (14.7)	0.62	0.38
OBC	223	189 (84.8)	34 (15.2)	0.61	0.39
SC	73	51 (69.9)	22 (30.1)	0.45	0.55
Kayastha	56	45 (80.4)	11 (19.6)	0.56	0.44
Muslims	220	176 (80.0)	44 (20.0)	0.55	0.45
Hindus	1006	798 (79.3)	208 (20.7)	0.55	0.45

Table 5 : Number and percentage of PTC tasters and Non-tasters and frequency of T and t Allele in different populations of Ambedkar Nagar District

Populations	Total No. of persons analysed	PTC		Allelic Frequency	
		Tasters	Non - tasters	T	t
Brahmins	267	193 (72.3)	74 (27.7)	0.47	0.53
Kshatriya	209	142 (67.9)	67 (32.1)	0.43	0.57
OBC	198	152 (76.8)	46 (23.2)	0.52	0.48
SC	69	52 (75.4)	17 (24.6)	0.50	0.50
Kayastha	97	74 (76.3)	23 (23.7)	0.51	0.49
Muslims	348	239 (68.7)	109 (31.3)	0.44	0.56
Hindus	965	770 (79.8)	195 (20.2)	0.55	0.45

Table 6: Showing Frequencies of T and t allele in different population of five districts of Uttar Prades

Populations	Sultanpur		Pratapgarh		Jaunpur		Faizabad		Ambedkar Nagar	
	T	t	T	t	T	t	T	t	T	t
Brahmins	0.50	0.50	0.55	0.45	0.52	0.48	0.54	0.46	0.47	0.53
Kshatriya	0.68	0.32	0.62	0.38	0.63	0.37	0.62	0.38	0.43	0.57
OBC	0.52	0.48	0.48	0.52	0.50	0.50	0.61	0.39	0.52	0.48
SC	0.43	0.57	0.37	0.63	0.41	0.59	0.45	0.55	0.50	0.50
Kayastha	0.38	0.62	0.52	0.48	0.52	0.48	0.56	0.44	0.51	0.49
Muslims	0.50	0.50	0.54	0.46	0.54	0.46	0.55	0.45	0.44	0.56
Hindus	0.50	0.50	0.48	0.52	0.53	0.47	0.55	0.45	0.55	0.45

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