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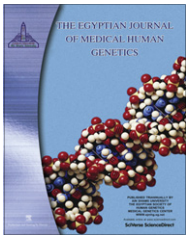

ORIGINAL ARTICLE

Genetic study of phenylthiocarbamide (PTC) taste perception among six human populations of Jammu and Kashmir (India)

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KEYWORDS

Phenylthiocarbamide (PTC);
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Genotype frequency;
Heterozygosity;
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Abstract *Background:* The ability to taste phenylthiocarbamide (PTC), a bitter chemical has long been known to be a bimodal autosomal trait inherited in a simple Mendelian recessive pattern which is being widely used for both genetic and anthropological studies. The frequency of taster and non-taster allele is found to vary in different populations. The present paper deals with the distribution of PTC tasting ability as a marker to study the genetic structure among Muslim populations of Jammu; as no detailed information is available.

Aim: To investigate the prevalence and gene frequencies of PTC taste sensitivity among male and females.

Subjects and methods: We have undertaken a survey of gene frequencies of PTC taste ability for six different endogamous groups including tribal population. PTC serial dilution method was used to assess the PTC taster and non-taster phenotypes. Hardy–Weinberg method was used to determine allele frequencies.

Results: Gujjar and Bakarwal population showed highest PTC threshold while Syed had the least. The phenotypic frequency for PTC taste ability varies within six populations; Syed were observed

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with highest taster frequency while Gujjar and Bakarwal had lowest taster frequency. The taster frequency of six different populations showed that the percentage of taster frequency was more frequent than that of the non-tasters. Also, females ($\chi^2 = 4.563$, df = 5, $p = 0.471$) had more PTC tasters than males ($\chi^2 = 5.254$, df = 5, $p = 0.385$), being statistically significant. The allelic frequencies in Gujjar and Bakarwal for non-taster (t) males and females were 55.86 and 54.55, respectively. In Syed population, t-allele frequencies for males and females were 45.75 and 37.79, respectively, while the other four populations showed intermediate t-allele frequencies. The heterozygosity showed little variation among all of the six populations.

1. Introduction

The North Indian human population and population from Jammu and Kashmir provide historical, linguistic, cultural, and socioreligious significance to the Indian subcontinent. Throughout the ages many population groups have migrated toward India along North-eastern and North-western routes [1]. Ethnic history of India reveals that Indians belong to two different categories: Dravidians (aborigines) and the Aryans or Sanskrit-speaking group (with mixed groups known as the Musalmans) [1]. Empirical studies indicate variable patterns of association among castes and tribes inhabiting wide geographic regions [2–4]. For example, Dravidian and Austro-Asiatic speaking tribes inhabiting different geographic regions show wide genetic diversity thus supporting the hypothesis of their heterogeneous origin, geographic isolation and migration history [2,4,5], whereas geographically proximate tribes and sub tribes within a region reflect close genetic affinity irrespective of their cultural and linguistic differences [6]. Diversity among Indian Muslims also shows close affinity because caste system is not rigid and they are not strictly reproductively isolated [7].

Muslims of India make up more than 13% of the population, and they belong to various castes based on linguistic and ethnic groups, besides a few tribes. According to the Indian census 2001, the human population of Jammu and Kashmir consists of 66.97% Muslims, 29.63% Hindus, 2.04% Sikhs, 1.12% Buddhists, 0.20% Christians, 0.024 Jains and 0.012% others. Muslims of Jammu and Kashmir belong to various castes such as Syed, Mughal, Malik, Mir, Bhatt, Khan, Lone, Pathan, Qureishi, Sheikh and many others based on their occupations. Gujjar and Bakarwal belong to Muslim population and is the major tribe of the state, densely populated in Rajouri and Poonch districts.

To understand the extent of biological affinity and diversity among the regional castes and tribes, we explored PTC classical genetic marker [8]. Genetic studies rely on variation, and substantial variation has been found in normal human taste abilities [9], opening the possibility of using genetic methods to improve our understanding of the sense of taste. The experience of bitterness occurs after certain chemicals contact taste receptors located in cells on the surface of the tongue. Some investigators hypothesize that this sense provides information so that people do not ingest bitter-tasting toxic chemicals [10]. Responses of humans to some bitter compounds show a bimodal distribution that distinguishes two phenotypes, tasters and non-tasters. The best-studied example of these is the ability to taste phenylthiocarbamide (PTC) and structurally related compounds [11]. Investigators reported that PTC-insensitive parents tended to produce PTC-insensitive children, and in many families where both parents were sensitive, 25% of their children were not [12]. Among population groups of India, the frequency of taster allele (T) is higher among population groups of Islands followed by North and South India and is low in West and Central India, as well as among scheduled tribes [13].

2. Subjects and methods

Jammu and Kashmir is situated between 32.17° and 36.58° North latitude and 37.26° and 80.30° East longitude. To its North is China and Russian Turkistan. On its East is Chinese Tibet. On the South and Southwest lie the Indian states of Punjab and Himachal Pradesh. On the West are the North West Frontier Provinces of Pakistan. The state of Jammu and Kashmir is 640 km in length from North to South and 480 km from East to West. The mountain chains that adorn the region include the Karakoram range, Nun Kun range, the Zanskar range, and Nanga Parbat. The survey was conducted from July 2011 to August 2011 for PTC taste ability in Rajouri and Poonch districts of Jammu and Kashmir. Nine hundred and eighty (980) individuals with the age range of 10–30 years were randomly selected from six populations viz., Gujjar and Bakarwal ($n = 241$), Mughal ($n = 142$), Khan ($n = 173$), Malik ($n = 145$), Mir ($n = 151$) and Syed ($n = 128$).

2.1. PTC threshold analysis

Taste sensitivity to PTC was ascertained using the serial dilution method by Harris and Kalmus [14]. A stock solution containing 0.13% phenylthiocarbamide was prepared in distilled water and serial dilutions were made up to the number thirteen. The least diluted solution was numbered as dilution number 14 and the most diluted solution was numbered as dilution number 1. If an individual could not taste any solution including 14, then he/she was designated a non-taster. The experiment was commenced with the weakest PTC solution in the order of increasing concentrations. Threshold levels for PTC were then recorded for males and females of each population.

2.2. Statistical analysis

Chi-square (χ^2) test is used for statistical analysis:

$$\chi^2 = \sum \frac{(\text{Observed frequency} - \text{Expected frequency})^2}{\text{Expected frequency}}$$

2.3. Gene frequency analysis

Genotype and allele frequencies for each population were calculated by Hardy–Weinberg method and heterozygosity was determined.