

Genetics of Phenylthiocarbamide perception among 250 Families in Northern Nigeria

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ABSTRACT: This study investigated the distribution and mode of inheritance of taster and non-taster genes among samples of Nigerian population from 20 Northern states using Phenylthiocarbamide (PTC) taste strip. Informed participants were asked to put the taste strip on their tongue and allowed to soak in the saliva before describing their taste perception. 250 families consisting of 1,200 individuals were randomly sampled. Overall, there were 948 and 252 are tasters and non-tasters representing 79% and 21% respectively. The allelic frequencies were 0.54 and 0.46 for tasters (p) and non-tasters (q) respectively and there were more female tasters than males. The ability to taste PTC among the population sampled was found to be bimodal while the inheritance pattern was found to be an autosomal incomplete dominant trait. Data analyses conform to Hardy-Weinberg principle. These observations show how northern Nigerians vary genetically with respect to their sense of taste.

Keywords: Phenylthiocarbamide, genetics, taste, bimodal, autosomal

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Introduction

Taste perception is known to influence individuals' qualities of foods and susceptibility to diseases (Prescott *et al.*, 2001). The ability to taste phenylthiocarbamide (PTC) is a genetic trait which has also been referred to as "an honorary blood group" (Mc Kusick, 1995). In other words, genetics plays a role in determining whether an individual is a taster or a non-taster. Fox (1931) was the first scientist to describe relationship between chemical constitution of PTC and tasting ability. Genetic variation in the sense of taster of individuals to various chemical compounds will provide the foundation for understanding the relationship between taster status, human taste perception and their associated consequential effect.

PTC, a bitter chemical synthesized by Fox (1931) has been widely used for genetic and anthropological studies (Kim *et al.*, 2003). PTC taste blindness has been the most studied trait in human genetics and second only to the ABO blood group system. The inability to taste PTC has been associated with a number of medical and neurological illnesses not typically related to taste. Previous studies have revealed that the inability to taste PTC is due to homozygosity for an autosomal recessive allele (Snyder, 1932; Guo and Reed, 2001). Today, it has been firmly established that the ability to taste PTC exhibits a strong dimorphism in human populations (Bahsin, 2006). Investigative reports are available regarding the association of non-tasters with diseases (Saldanha, 1956; Beinguelman, 1964; Branchel and

Walter 1974; Mourao and Salzano 1978). Since such association remains mere reports, further advancement in research towards this direction would be needed (Bahsin, 2006). Inability to taste PTC has also been associated with a number of medical and neurological illnesses not typically related to taste (Li *et al.*, 1990; Ali *et al.*, 1994; Moberg *et al.*, 2005; 2007).

Genetic approaches are fastly yielding new information about taste perception in human.

Several investigators (Harris and Kalmus 1949; Barnicot *et al.*, 1951; Merton, 1958) have reported that strong bimodal sensitivity distribution to PTC is caused by a common mechanism in which PTC-insensitive parents tended to produce PTC-insensitive children and in many families where both parents were insensitive, 25% of their children were not (Blackeslee, 1932). Several other investigators found that the Mendelian model of inheritance did not adequately explain their data and have therefore suggested multiple alleles, multiple loci and incomplete dominance genetic background as well as environmental modifiers (Ramana and Naidn; Olson *et al.*, 1989; Reed *et al.*, 2003).

Chromosomal location of PTC gene in recent studies has revealed that PTC sensitivity gene was located on chromosome 7 with major gene identified as a member of TAS2R bitter taste receptor gene family, TAS2R 38 (Kim *et al.*, 2003). These genes differ at three (3) amino acid positions number 49, 262, and 296 with the major taster form containing proline at position 49, an alanine at position 262 and a valine at

position 296 consisting the PAV form with the non taster forms. There is presently paucity of information on the genetics of Northern Nigerian population as regards to taste perception. Things taste different to different people. The difference in taste is determined by a single allele, designated as T and t, with t being recessive to T. Tasters could have either TT or Tt genes while non-tasters have tt. This widespread variation in the frequency of the two alleles among different populations has made PTC tasting to become one of the most frequently tested traits by human population geneticists (Guo *et al.*, 2001). This study was therefore conducted to investigate the distribution and mode of inheritance of taster and non-taster genes among samples of Nigerian population from 20 Northern states using Phenylthiocarbamide (PTC) taste strip.

Materials and methods

Ethical approval

This study was conducted with the approval of UI/UCH Institutional Review Committee via IRC protocol No: UI/IRC/02/0059 on a project entitled heredity and the sense of taste of the Nigerian population.

Taste strips

Phenylthiocarbamide (PTC) taste strips were obtained from Carolina Biological Supply Company® Burlington, North Carolina, USA and TRI-ESS Sciences, INC®, CA, USA.

Administration of Taste strips

This study was carried out in all the six Northern geo-political zones of the Federal Republic of Nigeria comprising of twenty states including Abuja, the Federal Capital Territory. A total of 250 families consisting of 1200 individuals were randomly sampled. The selected families were requested to put the taste strip on their tongue and allowed to soak in the saliva before describing their taste perception.

Results and Discussion

In this work, we studied the distribution and frequencies of taster and non-taster genes among Northern Nigerian families using PTC taste sensitivity. Our results showed that 21.0% (allele frequency 0.46) of the studied population was found to be non tasters of PTC. More non-tasters were found among the males compared to the females. When data were analyzed on geopolitical zones basis, all states of the Northern Nigeria have almost similar frequency of tasters and non-tasters. Our findings are significantly lower to previous reports on this subject in Nigeria. For example, Kalmus (1967) reported a value of 13.7% for the

alleles in an Ibadan population in southwestern Nigeria while Scott-Emuakpor *et al.* (1975) reported 12.50% ($t = 0.334$) and Odeigah (1994) reported 12.60% ($t = 0.335$). The differences in these reports and our study may be due to the sample size and sampling techniques utilized. Previous workers used sorting techniques while we administered PTC impregnated taste strips (Moberg *et al.*, 2007). Our study also used the largest sample size which included families and individuals from all the three geopolitical zones of the Northern Nigeria. The frequency (%) of non tasters obtained in this work is similar to those of other studies in Africa and other continents. Boyd (1950) reported 24.0% among Assut and 22.0% among Egyptians in Africa; Zhang *et al.* (1988) reported 23.0% among the Chinese while Eriksson *et al.* (1970) reported 22.1% among Europeans. The ability to taste PTC as sweet might have been a possible mutation of the PTC gene that predisposed them to be sweet tasters (Guo and Reed, 2001).

Assessment of PTC perception has been extensively used in science to demonstrate human diversity. It is at times assumed that PTC tasting ability occurs with equal frequencies in males and females. The present finding shows that the frequency of non taster alleles in the female is less than that of the males. Although this is statistically insignificant, it agrees with those of Odeigah (1994) as well as Brown and Corcos (1982) who reported similar findings among Nigerian subpopulation and US populations respectively. Our observations may be useful in anthropological studies and in human health effects. PTC itself has not been found in nature but the ability to taste PTC is strongly correlated with the ability to taste other naturally occurring bitter substances, many of which are toxic (Harris and Kalimus, 1949; Barnicot *et al.*, 1951; Tepper, 1998). For instance, non tasters of PTC tend to ingest a greater quantity of bitter tasting goitrogenic substances present naturally in edible plants which may exert greater thyroid stress. Such stress during intrauterine or early childhood growth and development might have effect on neurological maturation which in turn may make them more susceptible to epilepsy than tasters (Pal *et al.*, 2004).

Conclusion

This study has shown differences in the genetics of taste of the Nigerians using PTC taste strips. In line with previous observations on other genetic traits in the country (Mosuro, 1996; Bakare *et al.*, 2006; Azeezi *et al.*, 2007; Akinboro *et al.*, 2008), the Nigerian population varies genetically with respect to PTC taste.

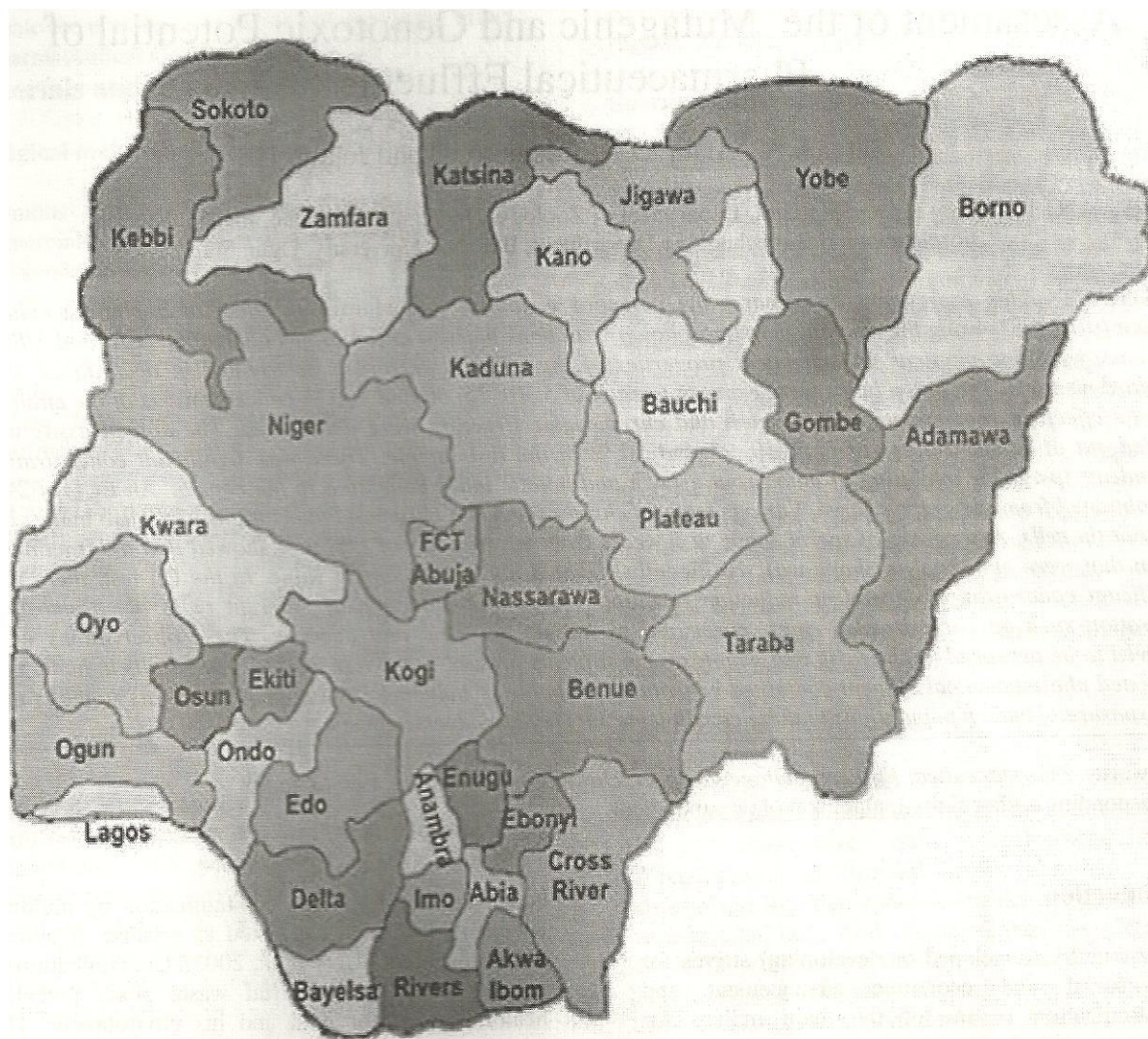


Fig.1 : Map of Nigeria

Table 1: Distribution of Tasters and Non-tasters to PTC according to age

Age-group	No of P.T.C Phenythiocarbamide		Percentage (%)		Allelic frequency	
Years	Tasters	Non-Tasters	Tasters	Non-Tasters	p	q
0-10	59	13	81.9	18.1	0.58	0.42
11-20	118	27	81.3	18.7	0.57	0.43
21-30	191	66	74.3	25.7	0.49	0.51
31-40	288	97	74.8	25.2	0.50	0.50
41-50	245	30	89.0	11.0	0.67	0.33
50 +	47	19	71.2	28.8	0.47	0.53
Total	948	252	79.0	21.0	0.54	0.46

Table 2: Distribution and allele frequency of PTC tasters and non tasters in Northern Nigeria.

Sample size	Tasters		Non-tasters		Allele frequency	
	Number	Percentage (%)	Number	Percentage (%)	T	t
Total (n=1200)	948	79.0	252	21.0	0.54	0.46
Males (n=967)	750	77.60	217	22.40	0.53	0.47
Females (n=233)	184	78.84	49	21.16	0.54	0.46

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