STUDIES ON THE SENSATION OF TASTE*

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It is a common knowledge that the sensation of taste is of four types, viz., bitter, sweet, salt and sour. Studies on the sensation of taste would be relatively easy to perform in man, and as such it is surprising that factors which govern the sensation of taste in man have not yet received wide attention. It has been shown that there are wide differences in the capacity of different individuals to taste phenylthiourea carbamide (PTC), a bitter substance (2) and such differences may be related to the presence of certain disease states like goitre (5) or diabetes (6, 9). There is a typical bimodal distribution of normal population with regard to threshold sensitivity of taste to PTC but the proportion of tasters to non-tasters varies from population to population (4, 7, 8). The present study was undertaken to ascertain as to whether the bimodal distribution is characteristic of PTC or it is also true for other bitter substances or for substances with salt, sweet or sour tastes. Comparative studies were performed with regard to taste sensation for PTC in adults and children. The effect of alcohol and glucose on acuity of taste sensation for PTC was also determined. There is a common belief that hunger produces increased acuity of taste sensation. Hunger is associated with hypoglycaemia and as such it was interesting to study the effect of glucose. The purpose of using alcohol was to test the old adage that alcohol is an appetizer.

MATERIALS AND METHODS

Subjects : The study was carried out in 100 medical students 19-21 years old, and in 339 school children 6-10 years old. The study on Indian school children was made on students from Bharatiya Vidya Bhavan, Delhi, whereas that on British children was made on school children in Charshalton, Surrey.

Drugs : The threshould sensation of taste was determined for PTC and for Naringin, another bitter substance obtained from the skin of grape fruit, for glucose (sweet), for citric acid (sour) and for sodium chloride (salt).

Technique : All the above substances were dissolved in water to give a concentration of 0.08 M. This was called the zero solution. Serial dilutions from this solution, using an equal amount of water (so that each was half the strength of the previous one) were prepared upto 13

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dilutions, and were named +1 to +13 solutions. Concentrated solutions containing 0.16 M (solution-1), 0.32 M (solution-2), and so on till 1.024 M (solution-7) were also prepared. The subjects were given the solution of the lowest concentration (solution-13) to taste first; next they tasted successive solutions until a definite taste was identified.

A particular strength of the solution was designated as threshold when a definite taste was recognized and the next lower number was discriminated as more concentrated, and the next higher one was found to be tasteless. Subjective reliability was checked by intermingling plain water with test solutions.

For obtaining population distribution curves the number of subjects was plotted graphically against the threshold taste sensitivity. The method adopted was essentially similar to that described by Harris and Kalmus (3).

The effect of prior administration of alcohol and glucose on taste sensation was tested in fasting subjects in the morning. The threshold sensation to PTC was determined following which 50 *g* of glucose in 500 *ml* of water or 30 *ml* of brandy (48% alcohol) in 250 *ml* of water was given by mouth. The mouth was thoroughly rinsed with water several times, and threshold sensations of taste was determined 30 min later.

The experiments, unless otherwise stated were performed between 9 A.M. to 12 noon.

RESULTS

I. Population distribution for various taste sensations :

The population distributions of adults (Indian) for taste sensations of PTC and Naringin are shown in Fig. 1. The curve for PTC shows two peaks, the left hand peak represent the tasters and the right hand peak represents the non-tasters (solutions, 0 to +4). The distribu-

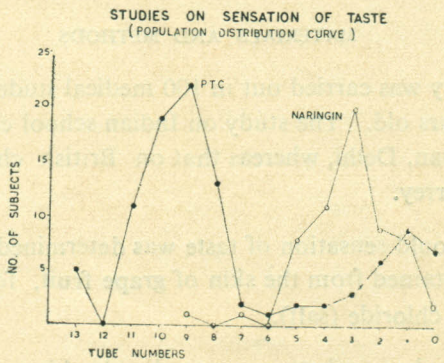

Fig. 1

Population distribution curves for phenylthiourea carbamide (PTC) and Naringin. The subjects were 100 *medical students belonging to the age group* 19-21 *years. The tube numbers refer to various solutions. Tube (O) contained* 0.08 *M. Tube* (1) *contained half the amount and each succeeding tube again contained half the amount of the previous one.*

tion for Naringin is unimodal. A similar unimodal distribution for Naringin was seen in adult British population as well. The population distributions for other taste sensations are compar-

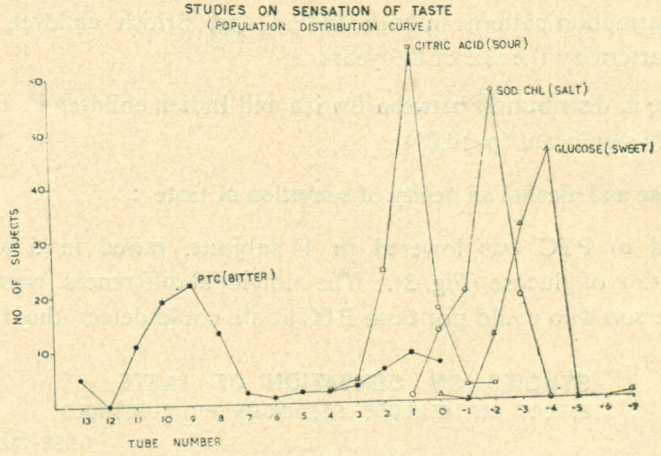

Fig. 2

Comparison of population distribution curves for bitter, sour, salt and sweet tastes. The subjects were 100 *medical students belonging to the age group* 19-21 *years. The tube numbering from* 0 *to* 13 *is the same as for Fig.* 1. *Tube* (—1) *contained* 0.16 *M and tube* (—2) *contained* 0.32 *M and so on.*

ed with similar distribution for PTC in Fig. 2. It can be seen that bimodal distribution is characteristic of PTC and is not seen with other substances. The acuity of taste sensation is maximal with PTC and minimal with glucose. If Naringin is taken as a prototype of a substance giving bitter taste, it is seen that peak distributions of bitter and sour taste are similar. The acuity of salt sensation is midway between these two and that of glucose.

II. Threshold sensation of taste for PTC in school children:

The results are shown in Table I.

TABLE I

The incidence of tasters and non-tasters of phenylthiourea carbamide in Indian and British school children.

Series	*Age group*	*No of subjects*	*Tasters (per cent)*	*Non tasters (per cent)*
Indian	6-7	43	79	21
	7-8	73	78	22
	8-9	53	74	26
	9-10	65	69	31
British	5-6	31	39	61
	6-7	25	40	60
	7-8	21	57	43
	8-9	28	71	29

An interesting difference in population distribution for sensation of taste of PTC was seen in children. The number of tasters amongst Indian children was nearly the same as in adults, but the number of tasters in British children belonging to age group of 5-8 years was much less. The distribution patterns in both Indian and British children approximated the adult distribution pattern by the age of 8-9 years.

The difference in distribution between British and Indian children in the age groups 6-8 years was statistically significant ($p<0.01$).

III. Effect of glucose and alcohol on acuity of sensation of taste :

The threshold to PTC was lowered in 11 subjects, raised in 5 and unaltered in 6 after the administration of glucose (Fig. 3). The individual differences were quite marked in certain cases. A person who could not taste PTC at all, could detect the taste upto tube 13

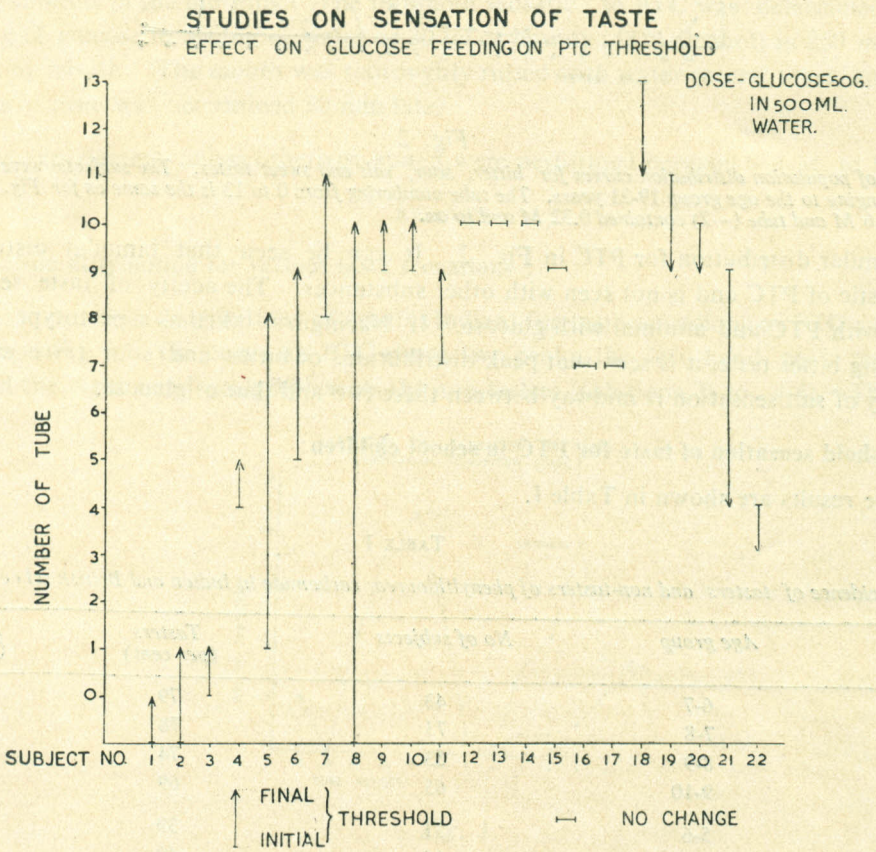

Fig. 3

Effect of glucose feeding on the threshold of taste sensation for phenylthiourea carbamide (PTC). The direction of arrow indicates the direction of change. The tube numbering is the same as for Fig. 1.

after glucose. The changes were not statistically significant ($p>0.05$). The alterations after alcohol were also irregular (Fig. 4). In a majority of cases, the acuity was slightly increased, but again the difference was not significant ($p>0.05$).

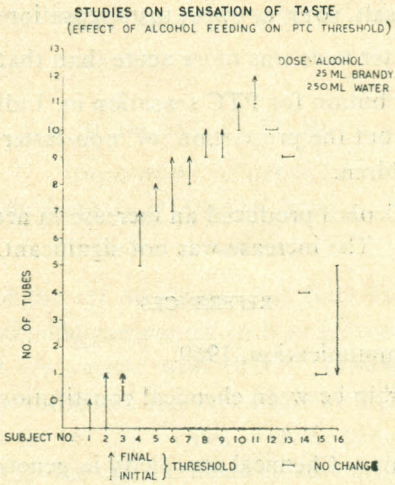

Fig. 4

Effect of alcohol feeding on the threshold of taste sensation for phenylthiourea carbamide (PTC). The direction of arrows indicates the direction of change. Tube numbering is the same as for Fig. 1.

DISCUSSION

A bimodal distribution of population for sensation of taste of PTC was confirmed. Approximately 28 per cent of Indians and British were non-tasters of PTC (detecting bitterness in 0 to +4 solution). The distribution of Naringin was unimodal and a similar distribution was seen for other types of sensation of taste. The capacity to taste PTC in low dilution is thus a special characteristic and there is considerable evidence to show that it is genetically transmitted. An interesting difference in population distribution for taste sensation of PTC was seen in children. The distribution in Indian children was similar to that seen in adults, but in Britain relatively larger number of children were non-tasters of PTC. The maximum number of non-tasters were in the age group of 5-6 years, and the number dwindled during the next two years. Akcasu (1) has reported that incidence of non-taster of PTC in adult population of Turkey is 5 per cent. He found that the incidence in children was 10% in the age group of 6-7 years; 5% in the age group of 8-9 years and 1% in the age group of 10-11 years.

The number of subjects on whom the effect of glucose or alcohol was tested was not large, but a tendency for increase in acuity of sensation for PTC was noted, though the results were not statistically significant.

SUMMARY

(1) There was a bimodal distribution of sensation of taste for PTC but not for Naringin, another bitter substance.

(2) The distribution for salt, sour or sweet taste sensations was unimodal.

(3) The sensation for bitter taste was more acute than that of others.

(4) The population distribution for PTC sensation in Indian children was similar to that noted in adults, but the proportion of non-tasters of PTC was significantly greater in British children.

(5) Feeding glucose or alcohol produced an increase in acuity of PTC taste sensation in majority of subjects. The increase was not significant.

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