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Ability to Smell Sodium Cyanide, Acetic Acid and Ammonia Among The Brahmins and Yadvas of Visakhapatnam City, Andhra Pradesh

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ABSTRACT The present article investigates the extent of variation of ability to smell sodium cyanide, acetic acid and ammonia among the school children of Brahmins and Yadavas of Visakhapatnam city of Andhra Pradesh. The curves of frequency distribution of the three substances are trimodal and bimodal in nature, suggesting probably the autosomal recessive inheritance of the non-smellers. Percentage of non-smellers for sodium cyanide was found to be much higher than acetic acid and ammonia. Bisexual as well as inter group differences were found to be non-significant for all the three chemical substances.

The differences in the ability to smell certain chemical substances among normal persons has been worth investigating in human population studies from the genetic point of view.

The inability to smell cyanide by some individuals was first reported by Mourant (1950). Kirk and Stenhouse (1953) have later used a simple method to acertain the frequency of inability to smell hydrogen cyanide (HCN) among the White population of Australia, following which attempts have been made to study the acuity of smell sensitivity of HCN in certain other populations, such as in Africans (Allison, 1953), Japanese (Fukumoto et al., 1957).

From India the studies of above nature have been few. While Srivastava (1961) reported on smell sensitivity to sodium cyanide alone. Reddy et al. (1981) investigated smell sensitivity to three substances namely sodium cyanide, acetic acid and ammonia.

These studies led to various hypotheses regarding inheritance, while Kirk and Stenhouse (1953) suggested sex-linked inheritance for the trait which Brown and Robinette (1967) rejected. Husur et al. (1958) described the trait as dominant, probably autosmal. Still this issue remains unresolved.

As such the present study has been undertaken to evaluate the variation occuring in the smell sensitivity to sodium cyanide, acetic acid and ammonia among the Brahmins and Yadava population, inhabiting the Visakhapatnam City, Andhra Pradesh.

MATERIAL AND METHODS

120 Brahmins (66 male and 54 female) and 155 Yadavas (80 male and 75 female) aged 12 to 16 years, consititute the sample for the present study.

Two grams of sodium cyanide (NaCN) were weighed accurately and dissolved in 20 ml of distilled water to get stock solution of 10% concentration from which succeeding serial dilutions (1,2, 3... 12) were made.

Similarly 1.6 ml of acetic acid and 2.5 ml of liquid ammonia were pipped out into two different measuring cylinders and each was made upto 20 ml to get 10% stock solution of acetic acid and ammonia. The succeeding serial dilutions were prepared from the respective stock solutions.

Kirk and Stenhouse (1953), has been adopted here for the present study, but for measuring the thresholds and ranks, serial dilutions of solution were given to the subjects instead of directly using the stock solutions. For this purpose alternate tubes of 10 ml of distilled water and 10 ml of solutions were presented to the subjects for smelling. Each of the subjects was asked to smell the distilled water first and then the tubes containing solutions in succession from the most diluted to the most concentrated solutions, and was asked to report if they smelled like the water or different. The first tube which provoked response different form that of water was taken as the threshold and its rank was noted in the proforma for the subject.

The allele frequencies of non-smeller and smellers calculated in the similar way as in case of those of nontaster and tasters for PTC taste sensitivity.

The calculation of the allele frequencies for the smellers (S) and non-smellers (s) gives as follows :

$$s = \sqrt{\text{Non} - \text{smellers}}$$

$$S = 1 - s$$

Where, non-smeller s is the percentile frequency of non-smeller.

RESULTS AND DISCUSSION

The distribution of the different smell thresholds for three chemical substances namely sodium cyanide, acetic acid and ammonia among males and females of the two populations are shown in tables 1 and 2.

Sodium Cyanide

It can be seen that these distributions are trimodal (Fig. 1) and the antimode falls at the solution 2 for both males and females among Brahmins. Whereas in Yadavas the antimode falls at solution 2 for both males and females

The antimodal value is taken for the separation of smellers form non-smellers. The mean threshold value is 5.0606 for males and 4.5741 for females among Brahmin, whereas in Yadava it is 4.8625 for male and 5.0400 for females. It is clear from the table 4, among Brahmins it was found that 23 out of 66 males (34.85%) and 17 out of 54 (31.48%) females were unable to smell sodium cyanide solution. The average frequency of non-smellers is 3.33% obtained from the pooled data. There is no striking difference between the sexes in the incidence of non-smeller ($\chi^2 = 0.1516$; $df = 1$; $0.70 > p > 0.50$).

In Yadavas 27 out of 80 males (33.75%), 26 out of 79 females (34.67%) were unable to smell sodium cyanide solution. The average frequency on non-smellers is 34.19% from the pooled data. No striking difference between the sexes in the incidence of non-smellers($\chi^2 = 0.146$; $df = 1$; $0.80 > p > 0.70$).

The frequency on non-smellers is slightly higher in Yadavas (34.19%) than in Brahmins (33.33%)

Acetic Acid

From the tables 1 and 2, distributions are bimodal (Fig. 1) and antimode falls at concentration 3 for males and in females the antimode falls at concentrations 2, among Brahmins. Whereas in Yadava the antimode falls at solution 3 for males and 2 for females.

The mean value of males and females of Brahmis are 7.5610 and 7.5930, respectively. From the table 4, the average non-smeller frequency is 10.00% obtained from the pooled data among Brahmins. In Yadava, the average non-smeler frequency is 5.806%.

The sex difference is not significant in Brahmins ($\chi^2 = 0.9918$; $df = 1$; $0.50 > p > 0.30$) and Yadavas ($\chi^2 = 0.3020$; $df = 1$; $0.70 > p > 0.50$).

The frequency of non-smeller is higher in Brahmin (10.00%), than Yadavas (5.806%).

Ammonia

From tables 1 and 2 the distribution of ammonia threshold also exhibiting bimodality (Fig. 3). Antimode falls at the concentration 3 for males and 4 for females among Brahmins.

Table 1 : Threshold distribution of smell for the three chemical substances among Brahmins (n = 120)

Thres-hold level	Sodium Cyanide						Acetic Acid						Ammonia					
	Male		Female		Total		Male		Female		Total		Male		Female		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0	14	21.21	11	20.37	25	20.83	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1	6	9.09	4	7.41	10	8.33	2	3.03	2	3.70	4	3.33	0	0.00	0	0.00	0	0.00
2	3	4.54	2	3.70	5	4.17	3	4.54	1	1.85	4	3.33	2	3.03	1	1.85	3	2.50
3	9	13.65	8	14.81	17	14.17	2	3.03	2	3.70	4	3.33	1	1.51	4	7.41	5	4.17
4	3	4.54	6	11.11	9	7.50	3	4.54	2	3.70	5	4.18	2	3.03	2	3.70	4	3.33
5	2	3.03	1	1.86	3	2.50	3	4.54	6	11.11	9	7.50	6	9.09	6	11.11	12	10.00
6	6	9.09	4	2.41	10	8.33	6	9.09	5	9.26	11	9.17	13	21.21	5	9.26	18	15.00
7	3	4.54	5	9.26	8	6.67	7	10.61	4	7.41	11	9.17	12	18.18	8	14.82	20	16.67
8	2	3.03	3	5.55	5	4.17	14	21.21	12	22.22	26	21.68	15	24.24	11	20.37	26	21.67
9	3	4.54	4	7.41	7	5.83	9	13.64	5	9.26	14	11.68	3	4.54	7	12.96	10	8.33
10	1	1.52	2	3.70	3	2.50	10	15.15	6	11.11	16	13.33	5	7.57	5	9.26	10	8.33
11	8	12.13	1	1.86	9	7.50	4	6.06	5	9.26	9	7.50	6	9.09	4	7.41	10	8.33
12	6	9.09	3	5.55	9	7.50	3	4.54	4	7.41	7	5.83	1	1.51	1	1.85	2	1.67

Table 2 : Threshold distribution of smell for the three chemical substances among Yadavas (n = 155)

Thre-shold level	Sodium Cyanide						Acetic Acid						Ammonia					
	Male		Female		Total		Male		Female		Total		Male		Female		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0	16	20.00	14	18.66	30	19.35	0	0.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1	7	8.75	8	10.67	15	9.68	3	3.75	3	4.00	6	3.87	0	0.00	1	1.33	1	0.65
2	4	5.00	4	5.33	8	5.16	2	2.50	1	1.33	3	1.93	2	2.50	3	4.00	5	3.23
3	14	17.50	8	10.67	22	14.19	1	1.25	4	5.33	5	3.23	3	3.75	1	1.33	4	2.58
4	3	3.75	6	8.00	9	5.81	2	2.50	3	4.00	5	3.23	2	2.50	4	5.33	6	3.87
5	2	2.50	3	4.00	5	3.23	5	6.25	6	8.00	11	7.10	5	6.25	9	12.00	14	9.03
6	5	6.25	4	5.33	9	5.81	7	8.75	9	12.00	16	10.32	17	21.25	8	10.67	25	16.13
7	4	5.00	5	6.67	9	5.81	9	11.25	8	10.67	17	10.97	14	17.50	15	20.00	29	18.71
8	5	6.25	2	2.67	7	4.52	8	10.00	14	18.67	22	14.19	18	22.50	10	13.33	28	18.06
9	6	7.50	3	4.00	9	5.81	13	16.25	10	13.33	23	14.84	6	7.50	8	10.67	14	9.03
10	1	1.25	6	8.00	7	4.52	15	18.75	7	9.34	22	14.19	10	12.50	12	16.00	22	14.19
11	8	10.00	7	9.33	15	9.68	11	13.75	4	5.33	15	9.68	3	3.75	3	4.00	6	3.87
12	5	6.25	5	6.67	10	6.45	4	5.00	6	8.00	10	6.45	0	0.00	1	1.33	1	0.65

Table 3 : Mean threshold values

Substance	Brahmin			Yadava		
	Male	Female	Total	Male	Female	Total
	$\bar{X} \pm S.E.$	$\bar{X} \pm S.E.$	$\bar{X} \pm S.E.$	$\bar{X} \pm S.E.$	$\bar{X} \pm S.E.$	$\bar{X} \pm S.E.$
Acetic Acid	7.5610±0.3333	7.5930±0.3810	7.5750±0.2508	8.1000±0.3065	7.4267±0.3217	7.7742±0.2228
Ammonia	7.3030±0.2666	7.3150±0.3220	7.3083±0.2070	7.2250±0.2236	7.2133±0.2754	7.2129±0.1774
Sodium Cyanide	5.0606±0.5264	4.5741±0.5060	4.8167±0.3689	4.8625±0.4582	5.0400±0.4819	4.9484±0.3310

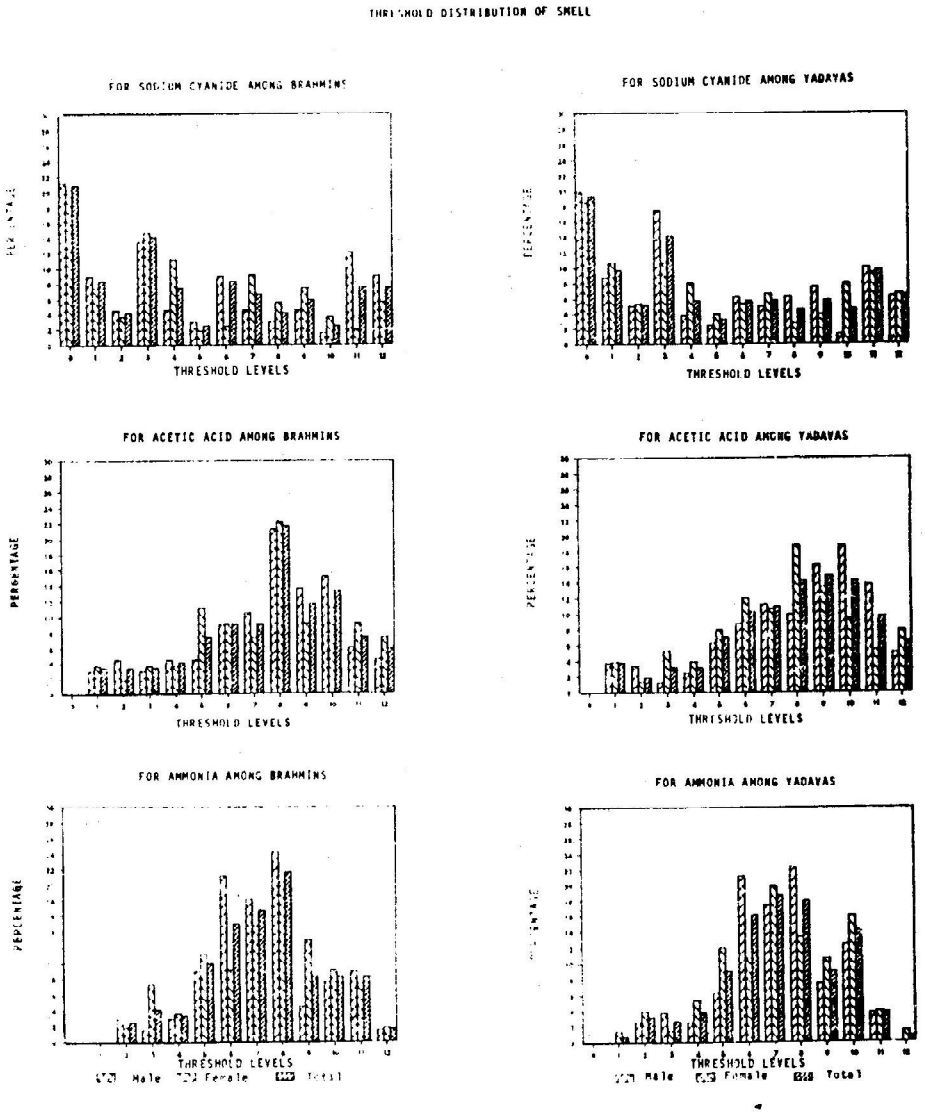
THRESHOLD DISTRIBUTION OF SMELL
FOR SODIUM CYANIDE AMONG BRAHMINS
FOR SODIUM CYANIDE AMONG YADAVAS
FOR ACETIC ACID AMONG BRAHMINS
FOR ACETIC ACID AMONG YADAVAS
FOR AMMONIA AMONG BRAHMINS
FOR AMMONIA AMONG YADAVAS
PERCENTAGE
THRESHOLD LEVELS
Male
Female
Total

Fig. 1.

Table 4 : Phenotype and allele frequencies of smellers and non-smellers for sodium cyanide, acetic acid and ammonia

Population/Sex	*Number tested*	*Sodium cyanide*				*Acetic acid*			*Ammonia*		
			Phenotype frequency	*%*	*Allele*	*Phenotype*	*%*	*Allele*	*Phenotype frequency*	*%*	*Allele*
Brahmins											
Male	66	Non-Smellers	23	34.85	0.5903	7	10.61	0.3260	3	4.55	0.7870
		Smellers	43	65.15	0.4097	59	89.39	0.6740	63	95.45	0.2130
Female	54	Non-Smellers	17	31.48	0.5611	3	5.56	0.2360	7	12.96	0.3600
		Smellers	37	68.52	0.4389	51	94.44	0.7640	47	87.04	0.6400
Total	120	Non-smellers	40	33.33	0.5773	12	10.00	0.1000	12	10.00	0.3162
		Smellers	80	66.67	0.4227	108	90.00	0.9000	108	90.00	0.6839
Yadavas											
Male	80	Non-smellers	27	33.75	0.5809	6	7.50	0.2738	7	8.75	0.2958
		Smellers	53	62.25	0.4191	74	92.50	0.7262	73	91.25	0.7042
Female	75	Non-smellers	26	34.67	0.5888	4	5.33	0.2309	5	6.67	0.2582
		Smellers	49	65.33	0.4112	71	94.67	0.7691	70	93.33	0.7418
Total	155	Non-smellers	53	34.19	0.5847	9	5.81	0.2410	10	8.45	.0.2626
		Smellers	102	65.81	0.4152	146	94.19	0.7590	145	93.55	0.7374

Whereas in Yadavas antimode falls at concentration 4 for males and 3 for females.

The means value of Brahmins is 7.3030 for males and 7.3150 for females. Whereas in Yadavas the mean values are 7.2875 for males and 7.1600 for females.

The sex difference in both Brahmins and Yadavas are not-significant, ($\chi^2 = 2.7549$; $df = 1$; $0.10 > p > 0.05$) and ($\chi^2 = 0.2372$; $df = 1$; $0.70 > p > 0.50$) respectively. The frequency of non-smeller, is high in Brahmins (10.02%) when compared with Yadavas (6.45%).

Further the intergroup differences for ability to smell the three substances namely sodium cyanide, acetic acid and ammonia are found to be non-significant.

Allele Frequencies

Table 4 shows the phenotype and allele frequencies of smellers and non-smellers and table 5 exhibits the chi-square values. As is evident form these tables, the bisexual and intergroup differences for ability to smell the three substances are found to be non-significant.

The smellers allele frequency is lower for sodium cyanide (Brahmin = 0.4227; Yadava = 0.4152) while it is higher for acetic acid (Brahmins = 0.9000; Yadavas - 0.7590) and ammonia (Brahmins = 0.6839; Yadavas = 0.7374). These are in close agreement with one observed for Muslims earlier reported by Reddy et al. (1981).

Comparatively the percentage of non-smellers for sodium cyanide is higher than in the case of acetic acid and ammonia for the both castes (Table 4).

As for all the three chemical substances, non-significant sex difference in the distribution of smell ability suggested no sex linkage which is an agreement with the earlier reports by Brown

Table 5 : Chi-square values

Chemical substances	*Brahmin (Males and females)*	*Yadava (Males and females)*	*Brahmin and Yadava*
Sodium cyanide	0.1516	0.0146	0.0222
Acetic acid	0.9918	0.3020	1.6909
Ammonia	2.7549	0.2372	1.1571

Degree of freedom = 1

and Robenetti (1967) and Reddy et al. (1981) but not by Kirk and Stenhouse (1953) and Srivastava (1961). Probably suggest the bimodal and trimodal distributions of the traits under study among Brahmins and Yadavas, autosomal recessive inheritance of the inability to smell the sodium cyanide, acetic acid and ammonia. As the number of subject is not large enough, age-wise distribution could not be attempted in the present study. A such future studies on smell ability to these chemical substances should throw light on the role of age and any other environmental factors in population variation.

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