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Original Article

Physiology Section

Taste Detection and Recognition Thresholds among Young Adults of Different Blood Groups: A Pilot Study

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ABSTRACT

Introduction: Individuals differ, sometimes extremely in their ability to perceive and enjoy the different qualities of taste and flavor. Present study tried to explore the relationship between different blood groups (ABO blood groups) and taste thresholds for five basic taste sensations.

Aim: To compare taste detection and recognition thresholds for basic taste sensations among individuals of different blood groups.

Materials and Methods: An observational cross-sectional pilot study was conducted in which total 100 young adults (males and females) in age group of 19-25 years were tested for taste Detection Threshold (DT) and Recognition Threshold (RT) for five basic taste sensations (sweet, sour, salty, bitter and umami). ABO and Rh blood groups of the subjects were determined, taste detection and RTs for basic taste sensations were compared among individuals of different blood groups. Data was analysed using SPSS V16 software and two-way ANOVA test was used.

Results: AB blood group subjects have low mean RT (0.0218±0.0085 Molar) for sweet taste and B blood group subjects have shown low mean DT value (0.0120±0.0079 Molar) for sweet taste. AB blood group subjects have low mean DT value (0.0078±0.0047 M) for salty taste. Low mean RT (0.0027±0.0017 Molar) for sour taste was seen for Blood group O. Bitter taste has lowest mean RT (0.0000117±0.0000039 Molar) for blood group A. Blood group O was found to have lowest values for both RT (0.037364±0.018087 Molar) and DT (0.011549±0.005707 Molar) for umami taste sensation. However, all the observed detection and RT were statistically non-significant.

Conclusion: Blood group alone cannot explain taste sensitivity as well as variations for particular taste sensation.

Keywords: ABO blood groups, Taste sensations, Taste threshold

INTRODUCTION

Taste is one of the five traditional senses belonging to special sensations. Taste is specialised type of sensation which determines ability of organisms to avoid certain types of food and prefer others. Basic taste sensations includes five established tastes; salt, sour, sweet, bitter and umami, with their separate existence and distinct entity been proved [1].

Food preference is given to food that tastes delicious and produces pleasant sensation in oral cavity. Flavour, texture and proper taste of the food form the concept of good taste [2]. Functional anatomy of taste perception in the human brain studied with positron emission tomography revealed significantly increased regional cerebral blood flow parameters in various areas of brain indicating significantly widespread activation of brain areas [3].

Many studies have found association of Phenylthiocarbamide (PTC) tasters and non tasters with different diseases which includes diabetes [4-6] dental caries [7], eye disease [8], thyroid disorders [9], schizophrenia [10], gastrointestinal ulcers [11], malignant tumours [12,13] and susceptibility to infectious disease [14].

One study observed significant increase in taste threshold for sweet taste to greater extent and for salt, sour and bitter test to moderate extent in diabetics as compared to non-diabetic controls [15].

Various studies have shown complex (non consistent) interaction between taste threshold for different taste sensations and body weight and its relationship with obesity [16]. Similarly, few have also confirmed age related (decline) changes in taste perceptions [17].

The blood groups are an individuals unique characteristic. Thirty-five types of blood group classification systems are established [18]. Certain blood groups are associated with particular chronic diseases, malignancies and infections [19-22].

A few studies explored relationship between ABO blood groups and PTC taste sensitivity among tribal population of South India and concluded that AB positive individuals of both sexes were all tasters while the AB negative were not [23].

However, literature search revealed absence of studies where attempt to explore taste Detection and RT and its relationship with ABO blood groups were done. The present study was attempted to compare taste thresholds for various taste sensations among different blood groups individuals so as to explore taste acuity in specific type of ABO blood group.

The implications of present study could be helpful in finding association between blood groups and taste threshold for different taste modalities. It will also help in finding association between taste threshold and preference of particular food type in different blood grouped individuals.

MATERIALS AND METHODS

An observational cross-sectional pilot study was conducted in Clinical and Human Physiology laboratory for a period of 2 months from August 2017 to October 2017. Sample size of 100 was taken using Convenience sampling technique. Total 100 (males and females) subjects in the age range of 19-25 years were enrolled for the study. After obtaining Ethical Clearance from IEC, (letter no: 09/GMC/I.E.C/2017) the study was initiated and informed consent for the same was obtained.

Inclusion Criteria

Healthy young adults with no history suggestive of systemic illness like hypertension, Diabetes Mellitus, nutritional disorders, endocrinal disorders, anaemia; Subjects without history or clinical features suggestive of acute upper respiratory infection, sinusitis, pharyngitis,

glossitis, oral ulcerations. Non-smokers, non-alcoholic subjects; Subjects without history of addiction, drug abuse; Subjects not taking any sort of drugs or medications; Subjects without any history of allergy to taste substances were included for testing taste sensations.

Exclusion Criteria

Subjects suffering from any medical condition which may hamper taste perception; Non compliant subjects were also excluded from the study.

Blood Group Testing

Blood group for each subject was tested by using commercial antisera (BHAT Bio-Scan) available in haematology laboratory in Department of Physiology. Blood groups (ABO) were determined using slide agglutination test performed using standard procedure and result was interpreted by observing visible agglutination. Any doubtful result was confirmed by observing agglutination under microscope.

Taste Threshold Testing

The substances used for determining taste sensation were Laboratory Grade chemicals- Sucrose, Sodium Chloride (NaCl), Citric Acid, Quinine Sulphate and Mono Sodium Glutamate (MSG). Standard chemicals for human taste examination were procured from LobaChemie Ltd., Mumbai (India). Stock solutions of varying strength were prepared using deionised water/distilled water. The starting concentrations were sodium chloride (1.00 Molar), Sucrose (0.5 Molar), Citric acid (0.05 Molar), and Quinine sulphate (0.001 Molar) and Mono-sodium glutamate (0.05 Molar). Solutions of varying molar strength (9 serial half dilutions) were used for each basic type of taste [Table/Fig-1]. Three to five subjects were called each day for testing the taste sensations. Subjects were advised to maintain 1-2 hours fast before starting the taste sensation examination. All the participants were explained about the taste sensation examination protocol in detail.

Test solutions (Molar)				
Sweet (Sucrose)	Salty (NaCl)	Sour (citric acid)	Bitter (quinine sulphate)	Umami (mono-sodium glutamate)
0.5	1	0.05	0.001	0.05
0.25	0.5	0.025	0.0005	0.025
0.125	0.25	0.0125	0.00025	0.0125
0.0625	0.125	0.00625	0.000125	0.00625
0.03125	0.0625	0.003125	0.0000625	0.003125
0.015625	0.03125	0.0015625	0.00003125	0.0015625
0.007813	0.015625	0.0007812	0.000015625	0.0007812
0.003906	0.007813	0.0003906	0.000007812	0.00003906
0.0001953	0.003906	0.00001953	0.0000003906	0.00001953

[Table/Fig-1]: Various taste solutions used for testing taste thresholds.

The taste solution (lowest concentration) was painted across the dorsum of the tongue using disposable glass rod. Subjects were asked if they perceive any of the basic taste sensations without taking tongue back into the mouth. Nonverbal clue like raising the finger by subjects was used to indicate perception of taste. After giving each solution for detection of threshold subjects were asked to rinse mouth with plane water till the taste sensation is washed out. If they don't perceive it, then higher strength solution was administered till the subject identified it separately from plane water. Rinsing of mouth was done every time before the subject was given different solution. Investigators recorded Taste DT and RT for all the five modalities of taste.

Detection Threshold (DT): The minimum strength of solution which was perceived different from the plane water was the taste DT for the taste in question [24].

Recognition Threshold (RT): The minimum strength of solution which was perceived clearly as distinct taste entity was the taste RT for the taste in question.

For taste DT and RT standard sequence i.e., sweet first followed by salt, sour, bitter and umami taste solution was used.

STATISTICAL ANALYSIS

Data was analysed using SPSS V16 software and two-way ANOVA test was used to compare taste detection and RTs for different modalities of taste sensations among different blood group individuals.

RESULTS

A total of 72 females and 28 males were included in the study with mean age of 20.33±1.36 [Table/Fig-2]. The highest number of study participants were of blood group B followed by O, A and AB [Table/Fig-3].

A statistically non-significant low mean RT (0.0218±0.0085 Molar) for sweet taste for blood group AB and non-significant low mean DT value (0.0120±0.0079 Molar) for sweet taste for blood group B was observed [Table/Fig-4a,b].

Sex	n	Age (years) (Mean±SD)	Height (cm) (Mean±SD)	Weight (Kg) (Mean±SD)
Females	72	20.33±1.36	158.10±7.84	55.11±11.54
Males	28	21.12±1.42	162.02±9.60	58.25±10.50

[Table/Fig-2]: Anthropometric data of study participants.

Blood group	Frequency	Percentage
A	12	12
AB	5	5
B	60	60
O	23	23
Total	100	100

[Table/Fig-3]: Blood group wise distribution of study participants.

Blood group	Sucrose RT (moles)			
	Minimum	Maximum	Mean	SD
A	0.007813	0.125000	0.033854	0.034351
AB	0.015625	0.031250	0.021875	0.008558
B	0.007813	0.062500	0.025130	0.011150
O	0.007813	0.062500	0.026834	0.013901
Blood group	**Sucrose DT (moles)**			
	Minimum	Maximum	Mean	SD
A	0.007813	0.031250	0.014974	0.010245
AB	0.007813	0.015625	0.012500	0.004279
B	0.003906	0.031250	0.012044	0.007921
O	0.007813	0.031250	0.012228	0.006998

[Table/Fig-4a,b]: Statistical analysis of blood groups and Recognition Threshold (RT), Detection Threshold (DT) for sweet taste.
ANOVA: Analysis of variance; F= 1.12; P=0.35; F= 0.47; P=0.71

For Salty taste, a statistically non-significant low mean RT(0.0157±0.0093 Molar) for blood group O and non-significant low mean DT value (0.0078±0.0047 Molar) for blood group AB was observed [Table/Fig-5a,b].

As far as sour taste is concerned, statistically non significant low mean RT (0.0027±0.0017 Molar) was for blood group O and non-significant low mean DT value (0.0008±0.0004 Molar) for blood group AB was observed [Table/Fig-6a,b].

Of all the taste modalities, Bitter taste has lowest mean RT (0.0000117±0.0000039 Molar) for blood group A followed by O, AB, B blood groups which have similar DT values. Lowest mean DT values were observed for blood group B (0.000020±0.000010 Molar) [Table/Fig-7a,b].

Blood group O was having nonsignificant lowest values for both RT (0.037364±0.018087 Molar) and DT (0.011549±0.005707 Molar) for umami taste sensation [Table/Fig-8a,b].

Blood group	NaCl RT (moles)			
	Minimum	Maximum	Mean	SD
A	0.007813	0.062500	0.023438	0.016320
AB	0.015625	0.062500	0.031250	0.019137
B	0.003906	0.500000	0.036914	0.088237
O	0.003906	0.031250	0.015795	0.009384
Blood group	NaCl DT (moles)			
	Minimum	Maximum	Mean	SD
A	0.003906	0.031250	0.014974	0.010644
AB	0.003906	0.015625	0.007813	0.004784
B	0.003906	0.031250	0.012435	0.007387
O	0.003906	0.031250	0.010530	0.006603

[Table/Fig-5a,b]: Statistical analysis of blood groups and Recognition Threshold (RT) and Detection Threshold (DT) for Salt taste.
ANOVA: Analysis of variance; F= 0.55; P=0.65; F= 1.48; P=0.23

Blood group	Citric acid RT (moles)			
	Minimum	Maximum	Mean	SD
A	0.0015625	0.006250	0.003255	0.001557
AB	0.0015625	0.006250	0.004375	0.002567
B	0.000781	0.0015625	0.003607	0.002931
O	0.000781	0.007813	0.002751	0.001792
Blood group	Citric acid DT (moles)			
	Minimum	Maximum	Mean	SD
A	0.000391	0.003125	0.001400	0.000949
AB	0.000391	0.0015625	0.000859	0.000428
B	0.000781	0.0015625	0.001641	0.002682
O	0.000391	0.007813	0.001121	0.001496

[Table/Fig-6a,b]: Statistical analysis of blood groups and Recognition Threshold (RT) and Detection Threshold (DT) for Sour taste.
ANOVA: Analysis of variance; F= 0.88; P=0.46; F= 0.43; P=0.74

Blood group	Quinine sulphate RT (moles)			
	Minimum	Maximum	Mean	SD
A	0.000078	0.000015	0.000011	0.0000039
AB	0.000015	0.000031	0.000023	0.0000078
B	0.000015	0.000031	0.000023	0.0000078
O	0.000015	0.000031	0.000023	0.0000078
Blood group	Quinine sulphate DT (moles)			
	Minimum	Maximum	Mean	SD
A	0.000010	0.000078	0.000024	0.000021
AB	0.000010	0.000039	0.000023	0.000015
B	0.000010	0.000039	0.000020	0.000010
O	0.000010	0.000039	0.000020	0.000011

[Table/Fig-7a,b]: Statistical analysis of blood groups and Recognition Threshold (RT) and Detection Threshold (DT) for Bitter taste.
ANOVA: Analysis of variance; F= 1.54; P=0.21; F= 0.63; P=0.59

Blood group	Monosodium glutamate RT (moles)			
	Minimum	Maximum	Mean	SD
A	0.015625	0.125000	0.044271	0.030410
AB	0.031250	0.250000	0.075000	0.097828
B	0.015625	0.250000	0.051042	0.049650
O	0.015625	0.062500	0.037364	0.018087
Blood group	Monosodium glutamate DT (moles)			
	Minimum	Maximum	Mean	SD
A	0.007812	0.015625	0.013021	0.003847
AB	0.007812	0.031250	0.015625	0.009569
B	0.000391	0.031250	0.015247	0.007909
O	0.007812	0.031250	0.011549	0.005707

[Table/Fig-8a,b]: Statistical analysis of blood groups and Recognition threshold (RT) and Detection threshold (DT) for umami taste.
ANOVA: Analysis of variance; F=1.11; P=0.35; F= 1.65; P=0.18

DISCUSSION

Present study tried to determine taste sensitivity for five basic taste modalities with respect to different blood groups (ABO system). Findings of present study revealed that AB blood group is sensitive for sweet, sour, salty taste. Blood group O is sensitive for salty, sour, umami taste. While bitter taste can be detected by blood group A individuals. Although the acuity observed is not statistically significant.

The phenotypes controlled by the genes determining blood groups were of neutral selective value in determining taste specificity. The taste specificity differences observed among different blood groups can be ascribed to nutritional needs which vary from individual to individual as well as among different species [25].

However, earlier Wise PM et al., emphasised possible role of genetic influences on sour taste RT in different blood group persons, and for individual differences in salt RT, they found greater role of environmental factors than genetic influences [26].

Other cause for taste threshold variation as mentioned by Reed D, which is applicable for supertasters is that these people have a higher density of fungiform papillae than others and that the increased number of taste receptors presumed to be embedded in these papillae translates to enhanced intensity perception [27].

More amplification of taste signal (central gain mechanism) which works in supertaster may also work additionally for variation in taste specificity among different individuals. Similar basis may be applicable and remains to be studied in detail for variation in taste threshold for different blood group persons.

Zhang GH et al., observed an inverse correlation between the fungiform papillae density and the DT for sucrose among young males [28]. Hence the taste bud density may be also the cause for variation in taste specificity which needs to be explored in further study. This type of taste papilla density measurements among different ABO blood groups individuals may put insight on the taste variation observed.

Receptor polymorphism is also the cause for variation in taste specificity as observed by Bufe B et al., and Galindo-Cuspinera V et al., for TAS2R38 bitter taste receptor protein which is the cause of variance in gustatory sensitivity to phenylthiocarbamide [29,30].

Thus, the flavor perception mechanism may be responsible for variations of taste sensitivity. Since the present study is preliminary with limited sample size and also there is scarcity in literature regarding similar type of studies, further study with large sample size over wide geographical location is needed to ascribe any definite relationship between blood groups and taste sensitivity.

LIMITATION

Limited sample size is the constraint of present study and similar study involving large sample size can be done for better result. Study duration was very limited (two months) hence large sample size could not be covered. It may be possible that due to small sample size our results were not significant.

CONCLUSION

Results of the study indicated no significant difference in taste detection and RT for basic taste modalities among study participants of different ABO blood group systems.

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