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PHYSIOLOGICAL TASTE THRESHOLD IN TYPE 1 DIABETES MELLITUS

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Abstract : The sense of taste is one of the important oral chemical senses that play a critical role in human life. The taste threshold increases by number of factors such as age, local and systemic disease like diabetes, consumption of alcohol, smoking. The aim of the present study was to assess the relationship between taste threshold in type 1 diabetics and non diabetics for four basic taste modalities (i.e. sweet, salt, sour and bitter). We studied 70 cases of type 1 diabetic and 70 non diabetics. The taste threshold was evaluated using 7 different serially half diluted concentrations of glucose (2.00 M–0.031 M), Nacl (1.00 M– 0.0156 M), citric acid (0.05 M–0.0007 M) and quinine sulphate (0.001 M–0.000015 M). A significant increase in taste threshold for sweet ($P<0.0001$), salt, sour and bitter ($P<0.001$) in type 1 diabetic was observed. We concluded that taste sensation was reduced in type 1 diabetics.

Key words : taste threshold type 1 diabetics non diabetics sweet salt sour bitter

INTRODUCTION

The sense of taste plays a critical role in the life and nutritional status of humans and other organisms. It can affect the health of the individual by altering the food preferences and food habit of the person.

Human taste perception may be categorized according to four well known and widely accepted taste qualities, sweet, salty, sour and bitter.

Taste disorders are common in the general population. Although these disorders can have a substantial impact on quality of life and may represent significant underlying disease, they are often overlooked by the medical community. The taste threshold increases by number of factors such as age, ethnic backgrounds, drugs, local and systemic disease, consumption of alcohol, smoking and tobacco chewing.

India is the host to the largest diabetic population in the world with an estimated 79.4 million people by 2030 (1). Diabetic patients appears to be especially prone to

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taste disorder, these disorders tend to appears during the course of disease (2, 3). However, the pathophysiology of taste disorders remains unclear in diabetes (4, 5). An association between taste impairment and diabetic neuropathies has been described (6) but remain disputed (7). In addition, drug used in type II (non insulin dependent) diabetes mellitus have been thought to impair taste threshold (8, 9). So we formulated the present study to compare the taste recognizing threshold in type 1 (insulin dependent) diabetic subjects and non diabetic subjects.

METHODS

Subject group consisted of 70 diagnosed cases of type 1 diabetics (38 males and 32 females) age range from 20–45 years attending diabetic clinic, department of Medicine, Government Medical College, Nagpur, and 70 age and weight matched non diabetic controls (40 males 30 females).

Inclusion criteria for diabetics :–

1) All type 1 diabetic subjects diagnosed at least one year prior to the study (8).
2) Subjects of IDDM (Type 1) with normal kidney function and without any obvious clinical evidence suggestive of metabolic complication of diabetes.

Inclusion criteria for Controls :–

1) Age and weight matched non diabetics subjects.
2) Having good dental hygiene and not subject to food allergies (10).

Exclusion criteria for diabetics and controls:–

1) Type 2 diabetes mellitus (8, 9).
2) Those who are on any prescribed medicine (10).
3) Smoking and alcoholics (10).
4) Hypertensive (10).
5) Pregnant and lactating women (10).

Precautions :

Following precautions were taken before starting the Experiment (11).

1) The subjects were asked not to smoke, eat or drink anything except water at least for one hour before the threshold measurements.
2) At the time of testing the entire procedure was explained to each subject.
3) Tests were carried out in the morning time between 8 to 11 am.

Taste stimuli : Stimulus representing the four classical basic tastes was included for tasting the recognition taste threshold for particular taste. Seven serial half dilutions of the stock concentration were made for each taste solution, by using deionised distilled water and used for experiment (12). The starting concentrations were glucose (2.00 M), sodium chloride (1.00 M), citric acid (0.05 M), and Quinine sulphate (0.001 M). The taste sensitivity for each solution was investigated as per Harris and Kalmus method assisted by forced choice and updown tracking procedure for better output and result (13). Subjects were given two or three drop of the solution of lowest concentration

on the dorsum of tongue to taste first and then tasted successive higher solution until a definite taste was identified. Distilled water was used in between two solutions for rinsing. Rinsing of mouth was repeated till the subject volunteer said that no taste of the previously tasted concentration lingers on. Accordingly the actual threshold concentration was determined and the bottle number noted. Standard sequence was followed for taste recognition threshold i.e. sweet first followed by salt, sour and bitter taste solution (14).

The statistical analysis was done by using Man Whitney 'U' test.

RESULTS

Taste recognition threshold for sweet taste (Table I):

It was observed that at 0.25 molar and lower concentration only twenty three diabetic subjects were able to recognize sweet taste properly while forty nine non diabetic subjects recognize it correctly. For higher concentration that is 0.5 molar and above, forty seven diabetic and twenty one non diabetic subjects recognized sweet taste properly. In general diabetic subjects were less sensitive than non diabetic subjects (P<0.0001) for sweet taste. Taste recognition threshold for salt taste (Table II):

TABLE I: Taste response to different concentrations of glucose solutions and number of type 1 diabetic and non diabetic subjects.

Bottle no.	*Glucose concentration (Moles)*	*Diabetics (70)*	*Non diabetics (70)*	*P value*
1	2.0 M	6	0	
2	1.0 M	16	5	
3	0.5 M	25	16	
4	0.25 M	20	35	<0.0001
5	0.125 M	3	10	
6	0.062 M	0	4	
7	0.03 1M	0	0	

It was observed that at 0.0625 molar and lower concentration only thirty one diabetic subjects were able to recognize salt taste properly while forty eight non diabetic subjects recognize it correctly. For higher concentration that is 0.125 molar and above, thirty nine diabetic and twenty two non diabetic subjects recognized salt taste properly. In general diabetic subjects were less sensitive than non diabetic subjects (P<0.001) for salt taste.

TABLE II: Taste response to different concentrations of Nacl solutions and number of type 1 diabetic and non diabetic subjects.

Bottle no.	*Nacl concentration (Moles)*	*Diabetics (70)*	*Non diabetics (70)*	*P value*
1	1.0 M	0	0	
2	0.5 M	3	0	
3	0.25 M	12	3	
4	0.125 M	24	19	<0.001
5	0.0625 M	28	38	
6	0.0312 M	3	7	
7	0.0156 M	0	3	

Taste recognition threshold for sour taste (Table III):

It was observed that at 0.00625 molar and lower concentration only forty three diabetic subjects were able to recognize sour taste properly while sixty non diabetic subjects recognize it correctly. For higher concentration that is 0.0125 molar and above, twenty seven diabetic and only ten non diabetic subjects recognized sour taste properly. In general diabetic subjects were less sensitive than non diabetic subjects (P<0.001) for sour taste.

TABLE III: Taste response to different concentrations of citric acid solutions and number of type 1 diabetic and non diabetic subjects.

Bottle no.	*Citric acid concentration (Moles)*	*Diabetics (70)*	*Non diabetics (70)*	*P value*
1	0.05 M	1	0	
2	0.025 M	5	0	
3	0.0125 M	21	10	
4	0.00625 M	28	31	<0.001
5	0.003125 M	10	20	
6	0.00156 M	5	7	
7	0.00078 M	0	2	

Taste recognition threshold for bitter taste (Table IV):

It was observed that at 0.000062 molar and lower concentration only twenty five diabetic subjects were able to recognize bitter taste properly while forty one non diabetic subjects recognize it correctly. For higher concentration that is 0.000125 molar and above, forty five diabetic and twenty nine non diabetic subjects recognized bitter taste properly. In general diabetic subjects were less sensitive than non diabetic subjects ($P<0.001$) for bitter taste.

Sex did not seem to have a major influence on our results because sex was not strongly associated with subjects status or complications.

TABLE IV: Taste response to different concentrations of quinine sulphate solutions and number of type 1 diabetic and non diabetic subjects.

Bottle no.	*Quinine sulphate concentration (Moles)*	*Diabetics (70)*	*Non diabetics (70)*	*P value*
1	0.001 M	2	0	
2	0.0005 M	7	1	
3	0.00025 M	18	14	
4	0.000125 M	18	14	<0.001
5	0.000062 M	17	19	
6	0.000031 M	8	18	
7	0.000015 M	0	4	

DISCUSSION

Diabetic patient appear to be prone to taste disorders. However, existing literature is not unanimous about the same. The present study conducted was mainly aimed at comparing the taste thresholds of type 1 diabetics and non-diabetics (controls) and to assess whether taste impairment occurs in type 1 diabetes. The result obtained and further analysis revealed that all four taste modalities i.e. sweet, salt, sour and bitter were affected and diabetics did show deterioration in the taste sensitivity to all taste sensations (3, 6, 15, 16).

Jorgensen and Buch (1961) reported that there is no difference for the sense of taste between diabetics and normal persons (4). Dye and Koziatek (1981) reported that diabetic subjects did not differ significantly in the threshold for sucrose from non diabetic subjects (5). However, other (17, 18) reports show altered threshold only for sweet taste and not for Nacl.

The subjects with type 1 diabetes have an early impairment of sensory perception suggesting that the manifestation of diabetes might even precede clinically recognized disease (7).

The underlying cause of taste impairment in diabetes is unknown, but the probable mechanism for the heightened thresholds could be explained on the basis of different school of thoughts. Taste impairment may be a degenerative complication of diabetes mellitus; due to neuropathy of the taste

nerves (8). Diabetes have significantly accelerated level of oxidative stress (19) and these almost certainly accounts to most diabetes complication i.e. neuropathy, cardiovascular, retinal, renal etc. Ford and Hermen (1994) have shown that diabetes mellitus is a free radical mediated disease (19).

Pathological changes in the peripheral nerves in diabetes appear much earlier than the outset of clinical symptoms of neuropathy and the myelin is affected more severely than the axis cylinder. This could be due to a metabolic abnormality inherent in the diabetic state (20). Other factors such as, duration and severity of hyperglycemia are only contributing to it (2, 16).

The other school of thought specifically points out towards a significant and specific impairment in glucose taste detection. It is said that in diabetics a taste abnormality for glucose might conceivably be due to frequent elevation of the blood sugar (a “satiation effect”) (18).

Inherent or acquired defect of the taste receptor (21), or abnormality of the mechanism underlying the central appreciation of taste within the brain (21), or microangiopathy involving the taste buds (21) may also be responsible for the taste impairment.

In present study, altered sensitivity for glucose (sweet taste) was highly significant as compared to other taste modalities, there by causing blunted taste for sweet foods and it may explain the craving for sweet food that is experienced by some of diabetic subjects. This may result in increased ingestion of sweet food and beverages and worsen the hyperglycemia.

The decrease in taste sensitivity may also reflect a generalized defect in cellular glucose sensitivity involving both the glucose sensing percentage beta cells as well the specialized taste cells in the tongue (22, 23).

However in the present study, subjects were in age range from 20-45 years and the duration of diabetes was not considered for recognition of taste threshold. Therefore further study is needed to exclude the effect of duration of diabetes on taste threshold, to consider taste function as a parameter of the course of diabetes.

In spite of deterioration in quality of life that taste disorder can induce, no specific treatment is available.

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