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Evaluation of Pattern of Dysgeusia in Cases of Type 2 Diabetes Mellitus

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Abstract

***Background**: Sweet, salty, sour, and bitter are four commonly recognized and acknowledged taste attributes that may be used to describe human taste perception. Although the relationship between Diabetes Mellitus and taste change is extensively researched, little is known about taste thresholds in diabetics, which points to the necessity for evaluation studies. Therefore, this research is conducted to assess the gustatory function in individuals with type 2 diabetes mellitus. **Methods**: A total of n=50 cases were studied in the study they were divided into two groups. Group (T): comprising of diabetes mellitus patients n=25 cases. Group (C) control group which comprises normal age and sex-matched controls n=25 cases. 1. Whole-mouth taste that is above threshold 2. A limited taste test in the area. Citric acid, sodium chloride, and sucrose solutions are used for this purpose (sour), and the bitter taste was avoided. **Results:** For whole mouth above threshold test: In group T, which included n=25 patients with diabetes mellitus for sweet taste n=15 reported neutral n=9 reported weak and n=1 reported strong taste. In group C out of n=25 controls n=15 was identified as weak and n=2 was identified as neutral and n=8 was identified as a strong concentration of sucrose solution. The p values were found to be 0.024 hence significant. The results of the localized spatial taste test for the tastes of sweet, salt, and sour in three separate groups are shown in Tables 3, 4, and 5. Sweet is the flavour most affected, followed by sour, and salt. After sour, and sweet, there was a highly significant variation in taste across the three groups. **Conclusion:** The current found that at least 50% of diabetics have some form of impairment of typical taste sensations which was more notable with a sweet taste. A blunted taste for sweet foods may lead to greater consumption of sugary foods and beverages, which may exacerbate any hyperglycaemia that already exists. Although future research should focus on enhancing taste receptor sensitivity, the current understanding of taste sensitivity may be used in dietary counselling to create meal plans and nutritional supplements.*

***Keywords**: Dysgeusia, Ageusia, Diabetes Mellitus type 2, Taste perception*

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Introduction

Taste or gustation perception is a crucial chemical sense in humans that affects the quality of life and ability to survive. [1] The sense of taste is one of the systems that control whether or not food is accepted or rejected and helps to prevent us from swallowing dangerous chemicals. The taste system recognizes umami, salty, sour, bitter, and sweet flavors. [2] Three main elements affect taste perception, an agent that causes flavor, a cell that detects taste, and a habitat that is made of water and supplied by saliva. The saliva plays a crucial part in taste by functioning as a solvent first, a transporter of flavor-evoking chemicals second, and by virtue of its chemical makeup third. [3] When the chemical concentration of a flavor reaches a threshold level, taste receptors get activated and

produce action potentials in gustatory nerve fibers that are intense enough to provide a feeling of taste. [3, 4] By changing a person's food preferences and eating habits, any change in taste perception can have an impact on that person's health. Taste changes are frequently linked to age, obesity, drinkers, smokers, disorders linked to renal failure, and patients with head and neck cancer. [5]

One such systemic condition that is particularly prone to taste disorders is diabetes. Both Diabetes mellitus type 1 (Insulin Dependent Diabetes Mellitus) and type 2 (Non-Insulin Dependent Diabetes Mellitus) have changes in taste as the condition progresses. It has been noted that people with Type 2 Diabetes Mellitus require meals heavy in carbohydrates; these people likely consume more sugar than people without diabetes. [6] Although the pathophysiology underlying taste impairment is still unknown, it may be caused by a genetically predisposed or acquired taste receptor defect, an abnormality in the brain's mechanisms controlling taste, peripheral neuropathy affecting the taste nerves, or microangiopathy affecting the taste buds. [4] According to studies, blood glucose levels have a direct impact on taste perception, blunting the taste response and encouraging a vicious loop that worsens glycemic management. Some researchers, however, discovered no association for the same. There is still debate about certain research that claims there is a connection between diabetes neuropathies and taste impairment. [4 - 6] Clinical taste testing for the whole mouth and localized detection of taste losses has been done using a range of techniques, including electrogustometry, somatosensory testing, and edible taste strips. [7] The whole mouth threshold tasting test is one of the techniques used in physiological taste testing to gauge a patient's capacity for detecting, identifying, and grading the intensities of four distinct sweet, salt, sour, and bitter concentrations. The alternative technique, called a spatial test, uses a cotton swab soaked in the prepared solutions to find taste impairment in specific regions of the oral cavity. Although the relationship between Diabetes Mellitus and taste change is extensively researched, little is known about taste thresholds in diabetics, which points to the necessity for evaluation studies. Thus, indicating the want for more evaluation research. Therefore, a study is conducted to assess the gustatory function in people with type 2 diabetes mellitus.

Materials and Methods

This study was conducted on patients with known Diabetes mellitus cases visiting the Dental OPD. The sampling strategy that was employed was the convenience sampling strategy. For the study, institutional ethical approval was obtained. All study participants provided their written permission. The demographic profile of the patients, including their personal history, history of their current condition, and family history, was filled out using a pre-tested and pre-validated questionnaire including the history of cardiovascular disease.

Inclusion criteria

1. The patients visiting the Dental OPD with a history of Diabetes mellitus type 2.
2. Males and females
3. On medications
4. DM of more one-year duration

Exclusion criteria

1. Patients with a history of tobacco and alcohol abuse
2. History of allergy to foods
3. Pregnant and lactating females
4. On medications other than oral hypoglycemics
5. Patients with a history of damage to the facial nerve

A total of n=50 cases were studied in the study they were divided into two groups. Group (T): comprising of diabetes mellitus patients n=25 cases. Group (C) control group which comprises normal age and sex-matched controls n=25 cases. Before the procedure, the individuals were instructed to fast for at least an hour and only consume water. A physiologic tasting test was conducted to assess gustatory function, which involves two distinct tests: 1. Whole-mouth taste that is above threshold 2. A limited taste test in the area. Citric acid, sodium chloride, and sucrose solutions are used for this purpose (sour), and the bitter taste was avoided. All three solutions were prepared in three concentrations Weak at 0.01 mol/L, neutral at 0.032 mol/L, and strong at 0.1 mol/L.

In the whole-mouth above-threshold taste test, the patients were given a row of three cups, each containing 5 ml of a taste solution in 1 cup and 2 cups of 5 ml of distilled water, but the contents were hidden from them. The individuals are told to sip the sample, swirl it about for about 10 seconds, and then expectorate it. The qualities of salty, sour, sweet, and tasteless were given to the participants to identify. Another row with the next greater concentration of the tasting solution was shown if the individual was unable to recognize the taste. The individuals were tested again when a precise decision was made until three straight accurate selections were achieved. The individuals were instructed to recognize the flavor and indicate it. Bitter taste was not used in this study to avoid patients' reluctance to use it and bitter taste effects may linger on for some time which may be uncomfortable for some patients.

Spatial tasting test

Each subject's localized taste function was evaluated during the spatial (localized) taste test. Each test stimulus' quality is determined, and it is then rated as Neutral, Weak, and strong. Each patient's results from the two tests—whole mouth over the threshold and spatial test—are tabulated for additional statistical analysis.

Results

Group T which is the test group included n=25 cases out of which n=15(60%) were males and n=10(40%) were females. The range of age was 38 – 64 years and the mean age was 46.5 years. In the control group (c) 60% of males were selected, and 40% of females were selected. The range of age was 35 years to 55 years and the mean age was 40.5 years. The p values were 0.128 hence the difference between the age was not significant between the groups. The details have been depicted in table 1.

Table 1: Demographic profile of the cases

	Males			*Females*		
	Frequency	*%*	*Mean age*	*Frequency*	*%*	*Mean age*
Group T	15	60	45.55	10	40	48.5
Group C	15	60	40.00	10	40	41.5

In group T the patients with DM had an average age of 5.1 years. In the same group, the mean duration of diabetes in males was 4.5 years and in females, the mean duration of diabetes was 5.5 years.

For the whole mouth above threshold test: In group T, which included n=25 patients with diabetes mellitus for sweet taste n=15 reported neutral n=9 reported weak and n=1 reported strong taste. In group C out of n=25 controls n=15 was identified as weak and n=2 was identified as neutral and n=8 was identified as the strong concentration of sucrose solution. The p values were found to be 0.024 hence significant details have been depicted in table 2.

Table 2: Whole mouth sweet taste differences

Taste	*Concentration*	*Group T*	*Group C*	*p-values*
Sweet	Weak	09(36.0%)	15(60%)	0.024*
	Neutral	15(60.0%)	02(08%)	
	Strong	01(04.0%)	08(32%)	
Salt	Weak	24(96%)	25(100%)	0.031*
	Neutral	1(04%)	0(0.00%)	
	Strong	0(0.00%)	0(0.00%)	
Sour taste	Weak	23(92%)	24(96%)	0.225
	Neutral	02(08%)	01(04%)	
	Strong	00(00%)	00(00%)	

* Significant

For the salt taste of the whole mouth, it was found that in the diabetes mellitus cases, 96% were able to identify it as the weak salt solution and 4% were not able to identify the solution similarly, in the control group all the 100% cases were able to identify the salt solution correctly. For sour taste in diabetes mellitus group T cases, 92% were able to identify it as a weak solution and 8% were not able to identify the taste of the solution. In the control group, 96% were able to identify the taste corrected and 4% were not able to identify the solution correctly the p values were >0.05 hence not considered significant given in table 2.

Localized Spatial Taste Test

The results of the localized spatial taste test for the tastes of sweet, salt, and sour in three separate groups are shown in Tables 3, 4, and 5 below. Sweet is the flavor most affected, followed by sour, and salt. After sour, and sweet, there was a highly significant variation in taste across the three groups. Because salt's average mean score stayed the same throughout all three groups, it did not demonstrate any comparative differences.

The three groups' mean summative spatial taste scores for each flavor were analyzed. We arrived at the following conclusions based on the findings with a P value of 0.01, there was a

very significant difference in sweet taste between all three groups. With a P value of 0.01, there was a highly significant difference in sour taste between all three groups. There was no statistical difference between the three groups for salt taste, therefore there was no difference between the three groups for the sour taste, which had a P value of 0.03, 0.04, and 0.02.

Table 3: Spatial sweet taste differences

Sweet Tate	*Concentration*	*Group T*	*Group C*
Tip of the tongue	Weak	20(80%)	24(96%)
	Neutral	05(20%)	00(00%)
	Strong	00(00%)	01(04%)
Dorsum of tongue	Weak	21(88%)	24(96%)
	Neutral	04(12%)	01(04%)
	Strong	00(00%)	00(00%)
Posterior aspect	Weak	22(88%)	23(92%)
	Neutral	03(12%)	00(00%)
	Strong	00(00%)	02(08%)
Right lateral	Weak	22(92%)	23(92%)
	Neutral	03(04%)	00(00%)
	Strong	00(00%)	02(08%)
Left lateral	Weak	22(88%)	23(92%)
	Neutral	03(04%)	01(04%)
	Strong	00(00%)	01(04%)

Table 4: Spatial salt taste differences

Salt Tate	*Concentration*	*Group T*	*Group C*
Tip of the tongue	Weak	22(88%)	21(84%)
	Neutral	03(12%)	00(00%)
	Strong	00(00%)	04(16%)
Dorsum of tongue	Weak	21(88%)	21(84%)
	Neutral	04(12%)	01(04%)
	Strong	00(00%)	03(12%)
Posterior aspect	Weak	20(80%)	21(84%)
	Neutral	05(12%)	00(00%)
	Strong	00(00%)	04(12%)
Right lateral	Weak	21(84%)	20(80%)
	Neutral	04(16%)	00(00%)
	Strong	00(00%)	05(20%)
Left lateral	Weak	21(84%)	21(84%)
	Neutral	04(16%)	01(04%)
	Strong	00(00%)	03(12%)

Table 5: Spatial sour taste differences

Sour Tate	*Concentration*	*Group T*	*Group C*
Tip of the tongue	Weak	18(72%)	21(84%)
	Neutral	06(24%)	00(00%)
	Strong	01(04%)	04(16%)
Dorsum of tongue	Weak	20(80%)	20(80%)
	Neutral	05(20%)	01(04%)
	Strong	00(00%)	04(16%)
Posterior aspect	Weak	19(76%)	19(76%)
	Neutral	06(24%)	00(00%)
	Strong	00(00%)	06(24%)
Right lateral	Weak	20(80%)	22(88%)
	Neutral	04(16%)	00(00%)
	Strong	01(04%)	03(12%)
Left lateral	Weak	22(88%)	21(84%)
	Neutral	02(08%)	00(04%)
	Strong	01(04%)	04(16%)

Discussion

An important chemical sense is a gustation. The taste buds in the oral cavity are primarily responsible for taste. It helps a person choose meals in line with the preferences and requirements of the host for particular nutritional components. [2] The human gustatory system can distinguish between a variety of flavor stimuli, which may mainly be divided into sweet, salty, sour, and bitter. [2] Although taste is negatively impacted in diabetes patients, they are not routinely evaluated for taste problems. [3] This may be due to the misconception that taste impairment is not a major issue like vision impairment in diabetes patients. As a result, patients often ignore little changes in their taste until they develop ageusia. [8] However, there is evidence that taste problems might alter food intake and affect metabolic regulation. One study found that more than one-third of adult diabetes patients had hypogeusia, which makes it difficult for them to maintain a healthy diet and results in inadequate glycemic guidance. [9] Although the fundamental cause of taste impairment in diabetes is unknown, it may be linked to long-term consequences of the condition, such as peripheral neuropathy, and long-standing disease. [3] Another possibility is that the taste receptors for glucose are intrinsically flawed. [4] Another hypothesis looks at a broad problem in type 2 diabetes that affects taste receptors as well as pancreatic B cells in the glucose-sensing receptors. [5] These might be considered the root reasons for taste impairment in this investigation. The first two years of the course of diabetes have shown evidence of taste impairment, raising the possibility that genetic factors may potentially be at play. Another possibility is that the persistently increased blood sugar levels in diabetes individuals will have an unspecific impact. [6] The physiologic taste evaluation, which employs tasting solutions for the four fundamental tastes of sweet, salt, sour, and bitter, is a prominent one of the approaches used in taste assessment. The physiologic taste perception between normal and diabetic participants is used in the current investigation. Whole mouth threshold taste and localized spatial taste are included in the investigation. In the current study,

hyposensitivity to sweet was shown to be the most prevalent (P value 0.01), followed by hyposensitivity to sweet, sour, and salt were in decreasing order. The results of the current study agree with those of the earlier ones. Our research reveals that out of n=25 patients, n=5 cases were hypogeusic to sweet taste, and n=2 cases were having ageusia.

Compared to the control group, this demonstrates a typical overall drop in the sweet taste among the diabetic groups. This is in line with the findings of several studies that have indicated diabetic people have the worst impairment of sweet taste. 5,6,46,54 Among the three tastes evaluated in the current study, salt taste displays the least taste impairment; nonetheless, there were no notable differences between the two groups. When comparing group T and group C there were significant differences in the evaluation of the whole mouth threshold taste for salt (P value 0.031). There is a severe deterioration of salt taste perception, according to some studies [3, 5] while other studies found that the salt taste is not significantly altered in diabetics. [8, 10] Despite the fact that only a few studies have indicated that diabetes patients' ability to taste sour foods is impaired. [4, 5] Our investigation found no evidence of a significant difference between the control group and the patients with managed diabetes. There are no discernible distinctions between group T and group C. Alterations in taste are also influenced by the aging process. It is usually believed that taste fades after the age of 60. According to earlier research, while the perception of sweet and sour tastes does not change with age, the sensitivity to salt and bitter tastes changes. [7, 11] Given these details, it can be concluded that the diabetes status of the individuals in the current study was the source of the taste modification since sweet and sour flavors exhibited more relevance of impairment than the age factor.

Conclusion

The current found that at least 50% of diabetics have some form of impairment of typical taste sensations which was more notable with a sweet taste. A blunted taste for sweet foods may lead to greater consumption of sugary foods and beverages, which may exacerbate any hyperglycemia that already exists. Although future research should focus on enhancing taste receptor sensitivity, the current understanding of taste sensitivity may be used in dietary counseling to create meal plans and nutritional supplements that taste sensitivity and preferences into account to change patients' perceptions and encourage them to consume less sugar.

***Conflict of Interest*: None**
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***Ethical Clearance*: Obtained**

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