Acetone Level and Salivary Oral Status Patient with Type 2 Diabetes Mellitus (In Vivo)

Ameta Primasari[1], Yumi Lindawati[1], Yendriwati[1], Almida Purnama Nasution[1], and Tulus Ikhsan Nasution[2]

[1] *Department of Oral Biology Faculty of Dentistry, Universitas Sumatera Utara Medan, Indonesia*

[2]*Departement of Physics, Faculty of Mathematics And Natural Sciences, Universitas Sumatera Utara Medan, Indonesia*

Keyword: Salivary flow rate, pH salivary, and acetone level

Abstract: Diabetes mellitus is a chronic metabolic disease characterized by hyperglycemia due to lack in the production of insulin produced by isled cell of pancreas, and systemic disease associated in oral manifestations. Reduction of salivary flow is one of the oral complication in patients with diabetes mellitus that can cause dry mouth, acidic pH and others. Acetone is the most abundant compound in the breath, acetone concentrations increased in patients with diabetes mellitus. **The objective** of this research is to analyze acetone level in mouth and salivary status (salivary flow rate and salivary pH) in type 2 diabetes mellitus patients, and to analyze the relationship between blood sugar levels and acetone levels, salivary flow rate, and salivary pH. This research is an analytical observational research with cross sectional and total sampling in this research were 31 patients by purposive sampling, measurement of acetone levels and salivary samples was carried out at Aviati Clinic Medan. Stimulated saliva respondents has diagnose as DM was collected by spitting for 5 minutes in the saliva pot. The salivary pH measurement using GC saliva test for pH and acetone level measurement using Diasen. Data were analysis using fisher's exact test. **The results** of this research showed the average salivary flow rate is normal with value 1,5 ml/menit, pH salivary normal with value 7,2, and acetone levels normal with value 377,38mV. Fisher Exact Test showed a significant relationship between blood sugar levels with salivary flow rate ($p< 0,05$) but did not show a significant association between blood sugar levels with pH salivary and acetone levels ($p>0,05$). Test graph to find out relationship between acetone levels with salivary pH, relationship between acetone levels with salivary flow rate, and relationship between salivary flow rate with salivary pH it was found there was correlation was significant. **The conclusion** of this research if salivary status normal in patient type 2 DM, it would appeared normal the acetone levels.

1 INTRODUCTION

Diabetes mellitus is a metabolic disease characterized by hyperglycemia due to absolute or relative decrease in insulin secretion or due to insulin resistance which results in a decrease in glucose into the cell and an increase in blood sugar levels, and changes in fat, protein and carbohydrate metabolism (Humairo, 2014).

Diabetes mellitus is divided into two types, namely type 1 diabetes mellitus (insulin dependent diabetes mellitus) and type 2 diabetes mellitus (noninsulin dependent diabetes mellitus). World Health Organization (WHO) estimates that in 2025 the number of people with diabetes mellitus will increase to 300 million people and will increase to 438 million by 2030 world wide, including type 2 DM patients. According to WHO estimates, 70% of the prevalence of DM is found in developing countries. The results of Regional Health Research (RISKESDAS) in 2013, the prevalence of diabetes mellitus in North Sumatra was 1.8% (Rikesdas and Riskesdas, 2013).

In people with DM, there are often several manifestations of the oral mucosa, some manifestations that often occur in the form of candidiasis, burning mouth syndrome, oral lichen planus, recurrent aphthous stomatitis, xerostomia and salivary gland dysfunction, in patients with type 2 DM there is a change in salivary flow rate and salivary components , decrease in salivary flow rate occurs due to parenchymal damage, changes in

Primasari, A., Lindawati, Y., Yendriwati, ., Nasution, A. and Nasution, T.
Acetone Level and Salivary Oral Status Patient with Type 2 Diabetes Mellitus (In Vivo).
DOI: 10.5220/0010076305000504
In *Proceedings of the International Conference of Science, Technology, Engineering, Environmental and Ramification Researches (ICOSTEERR 2018) - Research in Industry 4.0*, pages 500-504
ISBN: 978-989-758-449-7

salivary gland microcirculation, dehydration, and disturbances in glycemic contraction. Complications that are often found in patients with type 2 diabetes mellitus include, xerostomia, tooth loss, gingivitis, periodontitis, odontogenic abscess, and soft tissue lesions on the tongue and oral mucosa. In type 2 diabetes mellitus patients also have a significant decrease in salivary pH compared with non diabetes mellitus subjects and is associated with microbial activity or decreased bicarbonate which occurs simultaneously with salivary flow rates (Almeida, 2018), (Lopez, 2016).

Acetone (C3H6O) is one of the most abundant compounds in human breathing. Acetone is produced by heptocyse through decarboxylation from excess acetyl-Coa. Acetone formed by decarboxylation originating from lipolysis or lipid peroxidation. Ketone bodies, such as acetone are oxidized through the krebs cycle in peripheral tissues. Acetone concentration in breathing increases in uncontrolled patients with diabetes mellitus. The concentration of acetone in breath of people who do not suffer from diabetes mellitus is 800-900ppb, while patients with diabetes mellitus range from 1800ppb. Acetone causes bad breath, which is the smell of pears caused by ketoacidosis. this is a complication of oral cavity (Mitrayana, 2014), (Ozougwu, 2013).

2 MATERIALS AND METHODS

This study is an analytical observational research with cross sectional, and the total samples in this study were 30 patients and met the inclusion criteria are ages 40-55, patient with diabetes mellitus controlled, willing to participate in the study, in good health, has no other complicated diseases, and exclusion are alcoholic drinkers, copulate, smokers, not undergoing radiotherapy, patient with other complicated diseases, taking drug that affect secretion, mental disorders, unwilling to participate in the study, and using insulin.

Sampling of stimulated saliva and acetone levels is done after obtaining approval from the Medical Research Ethics committee of the Faculty of Medicine, Universitas Sumatera Utara and the patient has signed an informed concern sheet to be patient. The subjects were asked to fasting 2 hours before sampling, the sampling technique using draining method, the subjects were asked to chew wax paraffin, saliva accommodated on saliva pot for 5 minutes and labeled. Salivary flow rate (ml/minute), salivary pH was measured using GC salivary test for pH (Kasuma, 2015).

In the GC Saliva Check Buffer, normal values of mean salivary flow rate stimulated in healthy individuals range from 1.0 to 3.0 ml/min. It the value is below 0,7 ml/min then the condition is hyposalivated and if beetwen 0,1-0,25 ml/min then the value is very low. Salivary pH normal ranges from 6,8-7,8 and acid range from 6,0-6,6, very acidic ranges from 5,0-5,8. Furthermore, SPSS and STATCAL were used to perform classical assumption test and linear regression (Sutiksno, 2018), (Gio, 2013).

3 RESULT AND DISCUSSION

3.1 Result

Table 1 shows the average of normal salivary flow rate, salivary pH, and acetone levels in type 2 diabetes mellitus patients.

Table 1. Analysis of salivary flow rate, salivary pH, and acetone levels in patient with type 2 diabetes mellitus

Diabetes Mellitus Type 2		
Variable	n	$\bar{x}$ ± SD
Salivary flow rate (ml/minute)	31	1,5 ± 0,7
pH Salivary	31	7,2 ± 0,5
Acetone Levels (mV)	31	377,38 ±171,20

Table 2 shows the analysis results of of the relationship between blood sugar levels and salivary flow rate and salivary pH as evidenced by the significant Pearson Correlesion Test p <0.05 which showed that there was no correlation between fasting blood sugar levels and salivary flow rate, salivary pH, and salivary buffer capacity with a positive correlation type of closeness is very weak, which means the tendency of blood sugar levels will increase that cause salivary flow rates and salivary pH will increase.

Table 2. Analysis between blood sugar levels and salivary flow rate, Ph and salivary buffer capacity in type 2 diabetes mellitus patients.

Variable	Fasting Blood Sugar Levels	
	r	p
Salivary flow rate	0,181	0,527
pH salivary	0,043	0,820

Uji correlasi pearson

Table 3 shows the analysis results of the relationship of blood sugar levels with acetone levels using Pearson Correlation Test of significance p <0.05. The results obtained there is no significant relationship between blood sugar levels and acetone levels with a very weak type of positive correlation which means the tendency of sugar levels increased blood will cause acetone levels to increase.

Table 3. Analysis of blood sugar levels in patient with type 2 diabetes mellitus.

Variabel	Fasting Blood Sugar Levels	
	r	p
Acetone Leve	0,078	0,678

Uji correlasi pearson

Figure 1 shows the analysis results of salivary flow rate relationship with salivary pH using graph test. The result of this research showed a significant correlation.

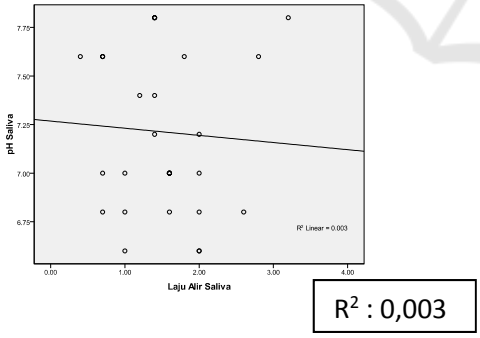

Figure 1. Relationship of salivary flow rate with salivary pH

Figure 2 shows the analysis results of salivary flow rate relationship with acetone levels using graph test. The result of this research showed a significant correlation between acetone levels and salivary flow rate.

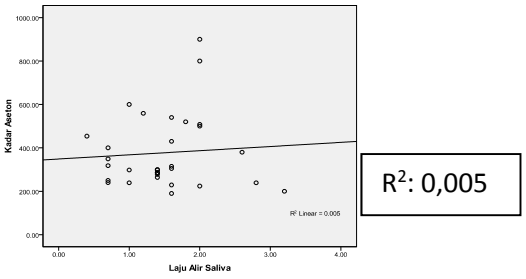

Figure 2. Relationship of acetone levels and salivary flow rate.

Figure 3 shows the analysis results of salivary pH relationship with acetone levels using graph test. The result of this research showed a significant correlation between salivary pH and acetone levels.

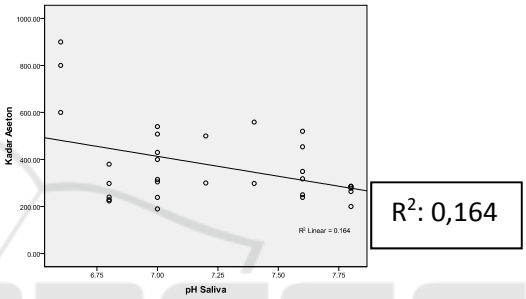

Figure 3. Relationship of acetone levels and salivary pH.

3.2 Discussion

In this research, the average patient had a normal salivary flow rate with a value of 1.5 ± 0.64, a pH of 7.2 ± 0.41 (table 1), and this research had the same results as the research of Bernadi et al (2007). The results of his research stated that the mean value of salivary flow rate (1.95 ± 0.73) and salivary pH (6.7 ± 1.8) in patients with controlled diabetes mellitus was normal. Research of (Prathibha, 2013) explains the average prevalence of salivary flow rate and salivary pH in uncontrolled type 2 diabetes mellitus patients, which is different from this research, that salivary flow rate 0.46 ± 0.02 categorized as hyposalivation (< 0.7ml / min) and value pH 6.69 ± 0.35 is categorized as low. The difference between the results of this research due to differences in research subjects and methods. Prathibha conducted an uncontrolled test of subjects with diabetes mellitus and methods of taking saliva with unstimulated spitting, while in this research conducted a test with controlled diabetes mellitus patients and used saliva spitting stimulation sampling methods (Prathibha, 2013).

Research by Lasisi and Fasanmade shows that salivary flow rate in uncontrolled diabetes mellitus patients is lower than controlled diabetes mellitus patients, with uncontrolled type 2 diabetes mellitus patients having a low salivary flow rate (Lasisi and Fasanmade, 2012).

(Karuniawani, 2015) stated that salivary gland secretion can be stimulated in several ways, such as with mechanical stimulation. By chewing food, chewing can increase salivary secretion because chewing activity will stimulate the parasympathetic nerves, and dilate blood vessels in the salivary glands. Salivary secretion is highly dependent on the nutrients supplied by the blood vessels to the salivary gland. (Roletta, 2002) states that stimulation with paraffin mastication increases salivary pH and, in this research, obtained an average salivary pH of 7.22, as known salivary pH is affected by salivary flow rate. The speed of stimulated salivary flow rate with paraffin mastication has increased, so that the salivary pH with stimulated flow rate will also increase (Karuniawati, 2015), (Roletta, 2002).

Glucose is a small molecule that capable to move easily inside the blood vessels membrane, which can be removed from blood plasma to gingival fluid through the gingival sulcus, and reach the saliva. Enhancement of blood glucose level in diabetes mellitus patients can lead to the increase of salivary glucose level (Sumintarti and Rahma, 2015).

The relationship between fasting blood sugar levels and salivary flow rate and salivary pH (table 2) has been tested using the Pearson Correlation of significance $p < 0.05$. Pearson Correlation between fasting blood sugar levels and salivary flow rate shows that a non-significant value ($p > 0.05$) with a very weak type of positive correlation ($r = +0.181$).

(Bernardi, 2007) stated that in the uncontrolled of controlled diabetes mellitus group, there was a change in salivary flow rate but not significant. In this research showed that there was a relationship between salivary flow rate and blood sugar levels. Blood glucose concentration indicates hyperglycemia is factor that influences salivary flow rates. In this research has found the results of normal salivary flow rate with high blood sugar levels. It can be influenced by other things that can stimulate salivary secretion. In this research using masticatory stimulation with paraffin candy which can increase salivary secretion (Bernardi, 2007).

Table 2 showed that there was not relationship between blood glucose and salivary pH in type 2 diabetes mellitus patient. Salivary pH value in the majorities of the research subjects had. Normal salivary pH value in fasting blood glucose with high, moderate, and normal categories, and there were only 3 patients had acid value. (Hedge, 2010) stated that, there was a significant differences between diabetes mellitus group and control group. Patients with diabetes mellitus had acid value in salivary pH, and it influenced by poor oral hygiene. Other research stated a different results. According to (Priyanto, 2017), there were not significant relationship between blood glucose level and salivary pH. There are several assumption that can explained why there wasn't any relationship between blood glucose level with the acidity of salivary pH. Blood glucose level had variation value that sometimes up and down which was due to the endogen factor of each respondents and was also affected by several non-physics and environmental factors. The decrease of medicine effect will leads to the increase of blood glucose level. while salivary pH affected by overall health factors such as diabetes mellitus disorders. Xerostomia is affected by local disturbances in salivary gland, medicine effects, and stress (Hedge, 2010), (Priyanto, 2017).

Table 3 showed that there was not relationship in blood glucose level with acetone level in type 2 diabetes mellitus patient. According to (Mitrayana, 2014), acetone is the most abundant compound in human airway system, and acetone concentration in airway system was increased in uncontrolled diabetes patient. According to (Muttaqin, 2012), blood glucose level and acetone concentration in saliva had a relationship, that patient with higher blood glucose will had higher acetone level in their saliva, however this research was done using spectroscopy. This research used diasen to assess the relationship between blood glucose and acetone level and this research showed that there wasn't any significant relationship using diasen. Diasen is a tool to detect the acetone level in breath that was applied to type 2 diabetes mellitus patient (Muttaqin, 2012).

Figure 1 showed that there was a relationship between salivary flow rate and salivary pH. Normal salivary pH value range 6-7 and depends on the flow rate. An acidic pH will affect the flow rate become viscous (Pandey, 2014).

Figure 2 showed that there was a relationship between acetone level and salivary flow rate. In graph 3 showed that there was a relationship between acetone level and salivary pH. There is a inverse relationship between salivary pH and acetone level, acid value in pH causes an increase in ketoacidosis, therefore acetone level also increases.

4 CONCLUSION

The subjects of this research, generally, had salivary flow rate, normal salivary pH and normal acetone levels with high fasting blood sugar level. The relationship between fasting blood sugar level, flow rate, and salivary pH is no significant relationship, acetone levels also do not have a significant relationship with fasting blood sugar levels. In this research, the relationship between acetone levels with salivary pH and flow rate has contained a significant relationship, also there was significant relationship between flow rate and salivary pH.

ACKNOWLEDGEMENTS

This study is funded by university of north sumatera according to the TALENTA research executing contract number : 2590/UN5.1. R/PPM/2018.16 march 2018.

REFERENCES

Humairo dan Apriasari. Studi Deskripsi Laju Aliran Saliva pada Pasien Diabetes Melitus di RSUD Ulin Banjarmasin. PDGI J 2014. 63(1): 8-13.

Badan penelitian dan pengembangan kesehatan depertemen kesehatan RI. Hasil Riset Kesehatan Dasar (RIKESDAS). Jakarta: badan penelitian dan pengembangan kesehatan depertemen kesehatan RI; 2013.h. 87-90.

Loporan Hasil Riset Kesehatan Dasar (RISKESDAS) Provinsi Sumatera Utara. Jakarta: badan penelitian dan pengembangan kesehatan depertemen kesehatan RI; 2013. h. 91-92

Prathibha K.M, Johnson P, Mathangi Ganesh, Arcot S.S. Evaluation of Salivary Profile Among Adult Type 2 Diabetes Mellitus Patients In South India. Clinical And Diagnostic Research J 2013; 7(8):1592-1595.

Almeida PDV, Gregio AMT, Machado MAN, Antonio Adilson, Luciana Reis Azevedo Machado. Saliva Composition And Functions: A Comprehensive Review. J Contemp Dent Pract 2008. (9)3: 1-11, 72-80.

Rosa Maria Lopez P, Elisabeth Casanas, Jose Gonzalez S, Julia Serrano, Lucia Ramirez, Lorenzo d, dkk. Xerostomia, Hyposalivation, and Salivary Flow In Diabetes Patients. Diabetes Research J 2016. 1-3.

Mitrayana, M.A.J. wasono, M.R. ikhsan. Pengukuran Konsentrasi Gas Aseton (C3H6O) Dari Gas Hembus Relawan Berpotensi Penyakit Diabetes Mellitus dengan Metode Spektroskopi Fotoakustik Laser. Fisika Indonesia J 2014. 18(54): 94-96.

Ozougwu J.C, Obimba K.C, Belonwu C.D, dan Unakalamba C.B. The Pathogenesis and Pathophysiology of Type 1 and Type 2 Diabetes Mellitus. J. Physiol. Pathophysiol 2013; 4(4): 46-57.

Nila Kasuma. Fisiologi dan Patologi Saliva. Padang: Andalas University Press, 2015. 22-26.

Dian Utami Sutiksno et al 2018 J. Phys.: Conf. Ser. 1028 012244.

Gio, P. U., 2013, Aplikasi Statistika dalam SPSS, USUpress.

Gio, P.U. and E. Rosmaini, 2015, Belajar Olah Data dengan SPSS, MINITAB, R, MICROSOFT EXCEL, EVIEWS, LISREL, AMOS, dan SMARTPLS, USUpress.

Lasisi T.J dan Fasanmade A.A. Salivary Flow And Composition In Diabetic And Non Diabetic Subjects. Niger.J.Physiol.Sci 2012. 79-82.

Karuniawati, N.M.P., Ns. I Wayan Sukawana, S.Kep.,M.Pd., Ns. Luh Gede Maryati, S.Kep (2015). Pengaruh Pemberian Latihan Mengunyah Menggunakan Permen Karet Terhadap Jumlah Sekresi Saliva Pada Pasien Dengan Diabetes Melitus Tipe 2. Diploma Thesis. Universitas Udayana.

Roletta H.E. Pengaruh Stimulasi Pengunyahan dan Pengecapan Terhadap Kecepatan Aliran dan pH Saliva. JKGUI. 2002. 9(1): 29-34.

Sumintarti dan Fildzah rahma. Korelasi Kadar Glukosa Saliva dengan Kadar Glukosa Darah Terhadap Terjadinya Kandidiasis Oral pada Penderita Diabetes Melitus. Dentofasial. Februari 2015. 14(1): 29-31.

Bernardi M.J, Reis A, Loguecio A.D dkk. Study of The Buffering Capacity, Ph and Salivary Flow Rate In Type 2 Well-Controlled and Poorly Controlled Diabetic Patients. Oral Health Prev Dent J. 2007. 5: 73-78.

Hegde A, Shenoy R, D'MeIlo P, Smitha A, Tintu A, Manjrekar P. Alternative markers of glycemic status in diabetes mellitus. Biomedical Research. 2010.21(3):252-256.

Priyanto M.H, Rusdi A, Tjut M.Z. Hubungan Kadar Gula Darah Sewaktu Dan HbA1c Dengan Derajat pH Saliva Pada Pasien Diabetes Melitus di RSUDZA Banda Aceh. Jurnal Ilmiah Mahasiswa Medisia. Februari 20017. 2(1): 28-34.

Muttaqin A, Mursaini T. Penentuan Kadar Gula Darah Pada Penderita Diabetes Melitus (DM) Melalui Uji Spektroskopi Aseton Dalam Air Liur. Ilmu fisika J. maret 2012.4(1):8-13.Renigier-Biłozor, Małgorzata dan Andrzej Biłozor 2015*Oeconomia copernicana***6**(4) 139 – 157.

Pandey AK. *Physiology of Saliva : An Overview*. J Dent Ind. 2014. 21(1): 32-38.