Dentistry 3000
Vol 13 No 1 (2025) DOI 10.5195/d3000.2025.774

Physiological Status of Some Selected Salivary Antioxidants in Dental Caries

Sulafa Khair Al-Deen Banoosh Alayoubi[1], Intesar Jasim Al-Kaysi[1], Hadeel Ayad[2], Esraa Azawi[4]

[1] *College of Dentistry, University of Tikrit, Iraq*
[2] *Ministry of Health, Iraq*

Abstract

Objective: Uric acid and total protein are the two main antioxidants in saliva, and dental caries is the oral disease that affects most of the total population. This study aimed to investigate the association between salivary antioxidants (uric acid and total protein) and dental caries in individuals between the ages of 20 and 30.

Materials and Methods: 50 subjects (18 males and 32 females) between the ages of 19 and 30 who attended the Efraz Health Center in Samarra city were recruited. Dental caries severity was evaluated using the DMFT and DT indices in accordance with WHO guidelines from 1997. Dental caries was divided into three categories based on scores: mild (0–10), moderate (11–20), and severe (21–and more). Salivary uric acid and salivary total protein concentration were assessed via chemical analysis of unstimulated saliva sample collection. The statistical package for social science (SPSS) version 21 was used to examine all data.

Results: Males had greater mean values for the DMFT and DT fractions than females, with the differences being statistically significant (p values of 0.05 and 0.001, respectively). Males also had higher salivary uric acid than females (P value of 0.001) and uric acid was associated with dental caries experience.

Conclusion: Salivary uric acid may act as a biomarker of dental caries. We found higher dental caries among subjects who had high levels of antioxidants.

Keywords: antioxidant, saliva, dental caries, total protein, uric acid.

Citation: Alayoubi SKAB, et al. (2025) Physiological Status of Some Selected Salivary Antioxidants in Dental Caries. Dentistry 3000. 1:a001 doi:10.5195/d3000.2025.774
Received: November 14, 2024
Accepted: December 19, 2024
Published: April 11, 2025

Email:sulafa.khairy@yahoo.com

Introduction

Dental caries is the local acid-induced deterioration of dental hard tissue that is sensitive to bacteria fermenting dietary carbohydrates. It is a complex illness where microorganisms are involved. It is the most common and persistent oral disease, especially in young children, due to the host, the substrate, and the modification of the immune system [1-3]. Dental caries carries a significant risk of morbidity [4].

Saliva, a biological liquid found in the oral cavity, plays a crucial role in maintaining oral health through several mechanisms, including salivary flow rate, buffer capacity, and defensive roles via antibacterial features and salivary antioxidant system [5].

Saliva unquestionably improves dental health; therefore, a lack of its secretion may be the onset of disease [6].

The antioxidants in our diet, along with intracellular antioxidants and those produced by enzymatic systems, can stop a variety of inflammatory, infectious, or tumoral processes [7].

Free radical levels rising has been identified as the common element in all these activities. A rise in oxidative damage and a decline in antioxidants have been linked to specific inflammatory conditions of the mouth, such as periodontal disease [8].

Antioxidants' unique function is to fight rogue free radicals, thereby lowering their destructive potential. They

Dentistry 3000
Vol 13 No 1 (2025) DOI 10.5195/d3000.2025.774

function as a singlet oxygen quencher, hydrogen donor, electron donor, peroxide decomposer, and synergist in addition to scavenging radicals [9].

It has been reported that uric acid is the main antioxidant in saliva, accounting for more than 85% of the whole antioxidant action of latent and stimulated saliva from both healthy and periodontally compromised subjects. Total protein is another example of a salivary antioxidant [10].

The primary byproduct of purine metabolism in humans is uric acid (UA), which is created from xanthine by the enzyme xanthine oxidase. Superoxide anion and other reactive oxygen products are formed during purine metabolism when molecular oxygen serves as the electron acceptor [11].

Uric acid may serve as a sign of oxidative stress and may also act as an antioxidant with potential therapeutic benefits. Additionally, pro-oxidants, like other reducing agents, can play a part, especially at higher levels [12].

lysozyme, lactoferrin, lactoperoxidase, immunoglobulins, agglutinin, and mucins are among the numerous proteins found in saliva that help to preserve the oral tissues [13].

Additionally, a number of peptides having antibacterial activity have been discovered. These include histatins, defensins, and LL-37, the sole cathelicidin produced by humans. There appears to be a significant overlap in functionality because each of these proteins and peptides exhibits a wide range of antibacterial action. This could explain the finding that oral disease susceptibility appears to be unrelated to the concentration of any one component [14].

Although the specific cause of this 'redundancy' is unclear, other features might be involved. The aim of this study was to find a relationship between antioxidants of saliva (uric acid and total protein) and dental caries.

Material and Methods

Subjects and dental examination

Fifty randomly chosen participants, who were treated at the Efraz Health Center in Samarra and ranged in age from 19 to 30 years, were examined between January and February 2020. Utilizing dental explorer and mouth mirrors, a clinical examination was performed.

The index used for assessment of dental status was: DMFT by W.H.O. methodology for caries status and treatment need (1997) [15] to calculate decayed (D), missing (M), and filled (F) teeth.

Saliva collection

Following the guidelines stated by Tenovuo and Lagerlöf [16], samples were collected. Each individual was instructed to rinse their mouth with distilled water in the morning after at least two hours of fasting. After 5 minutes, salivary samples began to be collected by spitting into plastic tubes until (Five ml) of unstimulating saliva was obtained. The sample was collected, centrifuged for 10 minutes at 3000 rpm, and the supernatant portion was aspirated and stored at (-20°C) for upcoming biochemical studies.

Biochemical analysis:

Salivary samples were stored for biochemical analysis. Total protein and uric acid levels in the saliva were measured calorimetrically using a spectrophotometer (Cecil CE 1011, UK). A ready kit (BIOLABO, France) was used to assess the salivary total protein and the salivary uric acid level, by exact following the manufactured instructions. Data analysis was conducted using Excel 2010.

Results

Table 1 shows the number and percentage of dental caries by

Dentistry 3000
Vol 13 No 1 (2025) DOI 10.5195/d3000.2025.774

both genders for all three groups [17].

Table 1. Caries severity percentage according to gender.

Severity of caries experience (DMFT index)	Males		Females		Total	
	N	%	No.	%	No.	%
mild (0-10)	11	61.1	28	87.5	39	78
moderate (11-20)	7	38.9	4	12.5	11	22
severe (21- and more)	0	0	0	0	0	0
Total	18		32		50	

Table 2 shows the mean and standard deviation of total protein in saliva and uric acid in males and females. Males had higher salivary uric acid than females ($p < 0.001$).

Table 2. Comparison between salivary antioxidant constituents in both genders.

Gender	N	Salivary Antioxidant Constituents	
		Total protein	**Uric acid**
		Mean ± SD	**Mean ± SD**
Male	18	1.50 ±0.15	**2.71 ±1.3**
Female	32	1.47 ±0.1	**1.37 ±0.87**
Total	50	1.47 ±0.12	**1.85 ±1.25**
p-value		**0.34**	**0.0008**

Table 3 shows the means and standard deviation of DMFT and DT indices in both genders. Males had higher caries experience than females ($p < 0.007$). Also, males had more decayed teeth than females ($p < 0.04$).

Table 3. Comparison between caries experience in different genders.

Gender	N	Caries-Experience	
		DMFT Mean ± SD	**DT Mean ± SD**
Male	18	8.55 ±4.89	**4.44 ±3.67**
Female	32	4.96 ±3.9	**2.68 ±2.56**
Total	50	6.26 ±4.61	**3.32 ±3.12**
p-value		**0.007**	**0.04**

Table 4 shows the mean and standard deviation of salivary total protein and salivary uric acid in the different groups based on DMFT.

Table 4. Comparison between salivary antioxidant constituents in different caries severity.

Caries Severity (DMFT) index	N	Salivary Antioxidant Constituents	
		Total protein	**Uric acid**
		Mean ± SD	**Mean ± SD**
Mild group	39	1.46 ±0.12	**1.7 ±1.1**
Moderate group	11	1.51 ±0.11	**2.37 ±1.5**
P-value		**p=0.11**	**p=0.1**

Table 5 shows the correlation of total protein and uric acid based on caries severity. It was found that there was a positive statistically significant correlation between DMFT and salivary uric acid.

Table 5. Correlation of dental caries severity and salivary antioxidant constituents.

Salivary antioxidant Constituents	DT		DMFT	
	r	p-value	r	**p-value**
Total protein	0.045	0.75	0.134	**0.35**
Uric acid	**0.102**	**0.48**	**0.371**	**0.007**

Dentistry 3000
Vol 13 No 1 (2025) DOI 10.5195/d3000.2025.774

Figure 1 shows the concentration of salivary total protein in different age groups.

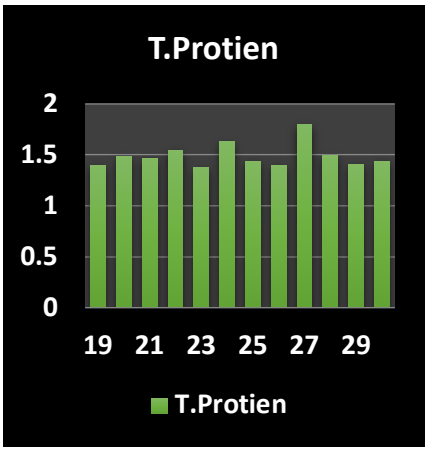

Figure 1. Total protein in different age groups.

Figure 2 shows the concentration (g/ml) of salivary uric acid in different age groups.

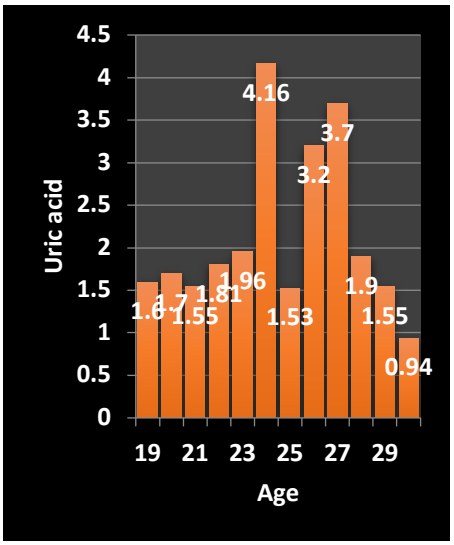

Figure 2. Uric acid in different age groups.

Discussion

In the present study, males had greater levels of salivary uric acid than females. Other studies [18,19] similarly found that males had considerably higher overall prevalence of hyperuricemia than females. This may be due to sex hormones, which increase renal urate clearance in women and decrease tubular urate post-secretory reabsorption in males [20]. The current study also discovered that salivary uric acid levels rise along with an increase in prevalence of caries. A similar finding was made by another study [21], and these findings may be explained by the fact that an increase in saliva's total antioxidant capacity may alter Streptococcus' adhesion to dental plaque and promote more cariogenic activity. In contrast, another study [22] found a negative correlation between salivary uric acid and caries prevalence. This may be due to enhanced production of reactive oxygen species (ROS) in the presence of bacteria by increased activity of neutrophils and monocytes in the oral cavity during phagocytosis [23]. It was found that antioxidants enhance oral health by providing protection against reactive oxygen species that induce damage of oral tissue especially gingival hyaluronic acid and proteoglycan.

In this study, the prevalence of dental caries was significantly higher in men than in women. This finding is in line with other studies [24], which attributed this finding to women's greater exposure to oral health information, stronger oral health beliefs, and greater frequency of preventive behaviors [25].

According to their site, location, and mode of action, salivary total protein may play a preventive function in dental caries or may promote the colonization of microorganisms [26].

This study found no link between salivary total protein and the occurrence of caries, which is consistent with other research's findings [27,29]. In contrast, a study by Nireeksha et al. [30] revealed that the mean salivary protein was lower in individuals with higher caries experience. This finding may be explained by the salivary proteins' protective effect against the free diffusion of acids on the tooth surface, which prevents the development of dental caries [30]. Salivary proteins also vary by age [31].

Conclusion

The findings of this study support the hypothesis that salivary uric acid may function as a biomarker of dental caries status. Higher dental caries experience was

Dentistry 3000
Vol 13 No 1 (2025) DOI 10.5195/d3000.2025.774

found among subjects who had high levels of antioxidants.

Conflicts of interest

The authors declare no competing interest.

References

1- Miralles L, Silvestre FJ, Hernández-Mijares A, Bautista D, Llambes F, Grau D. Dental caries in type 1 diabetics: influence of systemic factors of the disease upon the development of dental caries. Med Oral Patol Oral Cir Bucal 2006; 11: E256-60.

2- Okoye LO, Ekwueme OC. Prevalence of Dental Caries in a Nigerian Rural Community: A Preliminary Local Survey. Ann Med Health Sci Res. 2011;1:187–196.

3- Dawkins E, Michimi A, Ellis-Griffith G, Peterson T, Carter D, English G. Dental caries among children visiting a moble dental clinic in south central Kentucky: a pooled cross-sectional study. BMC Oral Health. 2013;13:19. doi: 10.1186/1472-6831-3-19.

4- Moses J, Rangeeth BN, Gurunathan D. Prevalence of dental caries, socio-economic old school going children of chid ambaram status and treatment needs among 5 to 15 year old school going children Of Chidambaram. J Clin Dign Res. 2011;5:146–151.

5- Liohong G, Wenyuan S. Salivary biomarker of caries risk assessment. J Calif Dent Assoc.2013 Feb; 41(2):104-118.

6- Lavelle CLB. Applied oral physiology, 2nd ed. London: Butterworths and Co (publishers) Ltd; 1988. p. 128–141.

7- Perno Goldie M. Antioxidants in oral health care: making the connection. Int J Dent Hyg 2005; 3: 93-95.

8- Brock G R, Butterworth C J, Matthews J B, Chapple I L C. Local and systemic total antioxidant capacity in periodontitis and health. J Clin Periodontol 2004; 31: 515-521.

9- Bagchi K and Puri S. Free radical and antioxidants in health and disease. Eastern Med HJ. 1998; 4:350-360.

10- Battino M, Ferreiro MS, Gallardo I, Newman HN, Bullon P: The antioxidant capacity of saliva. J Clin Periodontol 2002; 29: 189–194.

11- Baillie JK, Bates MG, Thompson AA, Waring WS, Partridge RW, Schnopp MF, Simpson A, Gulliver-Sloan F, Maxwell SR and Webb DJ "Endogenous urate production augments plasma antioxidant capacity in healthy lowland subjects exposed to high altitude". Chest (2007): 131 (5): 1473–8.

12- Glantzounis GK, Tsimoyiannis EC, Kappas AM, Galaris DA: "Uric acid and oxidative stress". Current Pharmaceutical Design. 2005; 11(32): 4145-51.

13- Nieuw Amerongen AV, Veerman ECI: Saliva – the defender of the oral cavity. Oral Dis 2002;8:12–22

14- Rudney JD, Hickey KL, Ji Z: Cumulative correlations of lysozyme, lactoferrin, peroxidase, SIgA, amylase, and total protein concentrations with adherence of oral viridans streptococci to microplates coated with human saliva. J Dent Res 1999;78:759–768.

Dentistry 3000
Vol 13 No 1 (2025) DOI 10.5195/d3000.2025.774

15- World Health Organization, Oral health surveys: basic methods, 4th edn. World Health Organization, Geneva, 1997.

16- Tenovuo J, Lagerlöf F. Saliva. In: Thylstrup A, Fejerskov O (eds.). Textbook of clinical cariology. 2nded. Copenhagen: Munksgaard; 1994. p. 17-43.

17- Sulafa K. BIOCHEMICAL RELATIONS OF Salivary magnesium, calcium, and phosphate WITH dental caries in adult; A Thesis Submitted to the College of Medicine at the University of Tikrit, 2012.

18- Jenna L Riis, Crystal I Bryce, Marla J Matin, John L Stebbins, Olga Kornienko,, Lauren van Huisstede, and Douglas A Granger, The validity, stability, and utility of measuring uric acid in saliva, Biomark in Medcine. 2018 Jun; 12(6): 583–596.

19- F. Mateos Antón, J. García Puig, T. Ramos, P. González, and J. Ordás, "Sex differences in uric acid metabolism in adults: evidence for a lack of influence of estradiol-17β (E2) on the renal handling of urate," Metabolism, vol. 35, no. 4, pp. 343–348, 1986.

20- Jain M, Singh A, Sharma A. Relationship of perceived stress and dental caries among pre university students in Bangalore City. J Clin Diag Res. 2014;8:131.

21- Raghad Ibrahim Kadhum, Alhan Ahmed Qasim, The impact of dental environment stress on caries experience, salivary flow rate and uric acid; J Bagh College Dentistry, Vol. 32(1), March 2020, p 35-41.

22- Rahmani M, Ghoorchi V, Rezaei F, Raygani AV. Evaluation of total antioxidant capacity of saliva in high school students. Global J health Sci. 2016;8:89-94.

23- Raja, S., Al-Tmimi, H. M., Ghadir, G. K., Mustafa, M. A., Alani, Z. K., Rusho, M. A., & Rajeswari, N. (2024). Original Research Article An analysis of polymer material selection and design optimization to improve Structural Integrity in 3D printed aerospace components.

24- Clement C. Azodo and Barnabas Unamatokpa, Gender difference in oral health perception and practices among Medical House Officers ; Russian Open Medical Journal 2012; 1: ISSN 2304-3415; p 1-4.

25- Masalu J, Mtaya M, Astrøm AN. Risk awareness, exposure to oral health information, oral health related beliefs and behaviours among students attending higher learning institutions in Dar es Salaam, Tanzania. East Afr Med J 2002; 79: 328-333.

26- Vibhakar PA, Patankar SR, Yadav MR, Vibhakar PA (2013) Salivary total protein levels and their correlation to dental caries. International Journal of Oral & Maxillofacial Pathology 4: 13-16.

27- Subramani, R., Mustafa, M. A., Ghadir, G. K., Al-Tmimi, H. M., Alani, Z. K., Haridas, D., ... & Kumar, A. P. (2024). Advancements in 3D printing materials: A comparative analysis of performance and applications. *Applied Chemical Engineering*, *7*(2), ACE-3867.

Dentistry 3000
Vol 13 No 1 (2025) DOI 10.5195/d3000.2025.774

28- de Farias DG, Bezerra AC (2003) Salivary antibodies, amylase and protein from children with early childhood caries. Clin Oral Investig 7: 154-157.

29- Roa NS, Chaves M, Gómez M, Jaramillo LM (2008) Association of salivary proteins with dental caries in a Colombian population. Acta Odontol Latinoam 21: 69-75.

30- Nireeksha1, Mithra N Hegde2*, Suchetha Kumari N3, Harshini Ullal4 and Vishakh Kedilaya, Salivary proteins as biomarkers in dental caries: In vivo Study, Dental, Oral and Craniofacial Research, 2017, Volume 3(2): 1-7.

31- Van Nieuw Amerongen A, Bolscher JG, Veerman EC (2004) Salivary proteins: protective and diagnostic value in cariology? Caries Res 38: 247-253.