

Original

Changes in Oral Dryness of the Elderly in Need of Care —The Effect of Dentifrice with Oral Moisturizing Agents—

Takafumi OOKA and Yoshiharu MUKAI

**Division of Hygiene and Oral Health, Department of Special Needs Dentistry,
Showa University School of Dentistry
1-5-8 Hatanodai, Shinagawa-ku, Tokyo, 142-8555 Japan
(Chief: Prof. Yoshiharu Mukai)*

Abstract: The aim of this study was to find a method for the elderly to cope with xerostomia and oral dryness. In particular, we investigated whether daily oral health care with a dentifrice that included a moisturizing agent could affect oral dryness. The subjects were 10 elderly women (mean age was 80.1 years old) who resided in a nursing home and were using a dentifrice that contained a moisturizing agent for daily oral health care. After three months of the beginning of using a dentifrice, the participants were classified into 2 groups, 5 women who continued to use the dentifrice and the others who stopped using the dentifrice for two months. An oral dryness evaluation was carried out with an oral mucosal moisture measurement and a saliva wetness test at the beginning of use of the dentifrice, three months and five months later. The oral mucosal moisture measurement of buccal and tongue mucosa indicated a significant improvement after 3 months of continued use of the dentifrice. However, all participants who had stopped using the dentifrice reverted to their prior oral dryness condition after five months. In the dentifrice group there was almost no variation for two months. These results show that application of a dentifrice with an oral moisturizing agent could improve the oral dryness of the elderly. When the elderly stop using the dentifrice, multidirectional intervention could be needed for fundamental improvement of oral dryness and xerostomia.

Key words: xerostomia, oral health care, elderly, moisturizing agent.

It is well known that saliva has important roles to maintain oral health: antibacterial activity, natural purification and a mucosal protective effect. Nevertheless, complaints about oral dryness and xerostomia have become increasingly common in recent years, and these symptoms are frequently shown in elderly people.¹⁻³⁾ Additionally, some studies have indicated that oral dryness is caused by a decrease in saliva production, thus, adversely affecting oral health and function.⁴⁻⁷⁾ Sjögren's syndrome, systemic lupus erythematosus and diabetes mellitus are diseases that bring on reduced secretion of saliva.⁸⁻¹¹⁾ It has been reported that the salivary gland function tend to become diminished in healthy elderly; however, the reduction of salivation in elderly is rarely different from that in young adults and there is little relationship between a decrease in saliva production and advancing age.¹²⁾ As it stands now, a decrease of

oral function, which may be affected by feeding and the taking of numerous medications, could contribute to oral dryness or xerostomia; it is, therefore, an important issue that needs to be dealt with.¹³⁾

Some methods used for xerostomia include administering artificial saliva and the use of pharmacological agents to develop secretion of saliva.^{14,15)} However, these results indicate that patients with xerostomia had little beneficial effect or the duration was not long enough to remedy oral dryness.

In recent years several varieties of oral moisturizing gels for relief of oral dryness have gradually been coming into use.^{16,17)} The moisturizing gels are easier to keep in the oral cavity than artificial saliva, and the gels can easily be used by a caregiver or by the elderly themselves. Therefore, these oral moisturizing products have been made available for nursing-care facilities and at-home

care. Some studies show that oral moisturizing gels for xerostomia have evanescent advantages for xerostomia caused by preoperative radiation treatment or Sjögren's syndrome.¹⁸⁻²⁰⁾ On the other hand, little research refers to the effect of oral moisturizing agents for xerostomia and oral dryness of the elderly, notably long-term changes of oral conditions.

The aim was to find a method for the elderly to cope with xerostomia and oral dryness. In particular, the changes and effectiveness were investigated whether daily oral health care with a dentifrice that included a moisturizing agent could affect oral dryness.

Subjects and Methods

The subjects were 10 elderly women who resided in a nursing home in Tokyo. All of the women showed xerostomia clinically in a dental check-up. The mean age was 80.1 years; the youngest woman was 72 years of age and the oldest was 94 years of age. Their nursing care level was 4 or 5, and only the caregivers of the nursing home cared for the subjects' oral health. Additionally, all participants had either partial or complete dentures and could easily eat meals. The subjects took daily medicines, including antihypertensive drugs, which might cause a decrease in saliva secretion. The subjects or their families were given an explanation of this study, and signed consent was obtained from each participant. The degrees of oral dryness of the objects were evaluated by the following two examinations:

1) Oral mucosal moisture measurement

The dryness of the tongue and the buccal mucosa were measured by an oral moisture tester (Mucus, LIFE Co., Ltd., Koshigaya).²¹⁻²³⁾ The tester measured the dorsal surface area of the tongue 10 mm from the tip, and the buccal mucosa from the angulus oris. Each measurement was repeated 3 times, and an average was calculated as a representative value. Figure 1 shows the measurement position of the oral mucosa.

2) Saliva wetness test (KISO-WeT, KISO science Co., Ltd., Yokohama)

A saliva wetness test was used for evaluation of

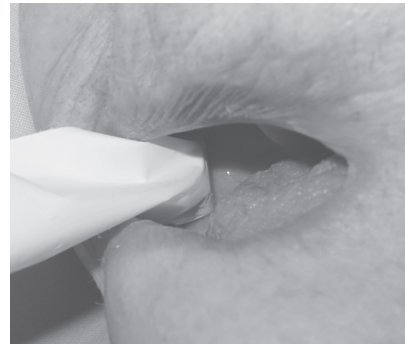


Fig. 1 The measurement position of oral mucosal moisture.



Fig. 2 The situation of saliva wetness test.

Table 1 The criteria of oral dryness in this study.

Oral mucosal moisture measurement		Saliva wetness test	
Normal	Over 30	Normal	Over 5 mm
Boundary	29~30	Slightly-dry	3~5 mm
Slightly-dry	27~29	Moderate dry	Under 3 mm
Moderate dry	25~27		

sublingual dryness as shown in Fig. 2. The tester was placed on the mucosa of the sublingual area for 10 s and then evaluated by a half of a millimeter.²⁴⁾

Both of the oral dryness evaluations were based on previous studies and were carried out from 9 to 11 a.m.²¹⁻²⁴⁾ The criteria of evaluation are represented in Table 1. The above-mentioned oral dryness measurements were done at the onset of intervention, and after 3 and 5 months, respectively. In this study an oral care gel including a moisturizing ingredient (REFRECARE-H, EN Otsuka Pharmaceutical Co., Ltd., Tokyo) was used as the specimen. At the time of intervention onset, caregivers of the nursing home received a clear explanation regarding the use of the moisturizing oral care gel

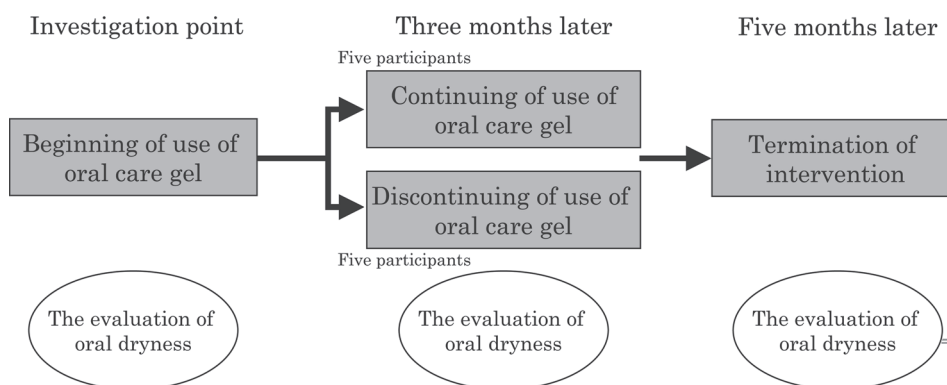


Fig. 3 Schema of the investigation program.

and oral health care method. The caregiver used a dollop of the dentifrice (approximately 1 cm in size) with a toothbrush and an oral swab twice daily (after breakfast and dinner).

In particular, the participants were told to avoid using an excess amount of the gel around the hard palate and the tongue. No one was allowed to use another brand of toothpaste and/or oral gel during the study period. In addition, during the investigation period and once a month, the caregivers underwent checks concerning the method of oral care by a dentist.

Three months later, the subjects were divided into 2 groups on the basis of the changes regarding their oral dryness. Five of the participants were classified to a group to continue using the dentifrice; caregivers were responsible for cleaning the oral cavities of the subjects. Alternatively, the remaining participants stopped using the dentifrice and continued to receive oral health care by the caregivers in a similar way. The classification was initiated to avoid a bias between the oral mucosal moisture measurement and saliva wetness test of the groups. A schema of this investigation program is shown in Fig. 3.

All the objects received the same measurement and test 2 months later, and the effects of the oral moisturizing gel were evaluated.

The results of the oral mucosal moisture measurement and the saliva wetness test were compared statistically by chi-squared test. Moreover, the result of oral mucosal moisture measurement and saliva wet test of continuing

and discontinuing groups among investigation point, 3 months later and 5 months later were compared by repeated measure ANOVA and Bonferroni-Dunn test were calculated by SPSS 14.0J (SPSS Japan Inc., Tokyo). The p-value of less than 0.05 was considered to indicate a significant difference for chi-squared test and two-way ANOVA for Bonferroni-Dunn test.

All experimental protocols were approved by the Ethics Committee of the School of Dentistry, Showa University (Approval Code: 2008-36).

Results

The buccal and tongue mucosal measurements of the pre and post intervention are shown in Fig. 4. No subject was evaluated normal in this measurement before using the moisturizing dentifrice. After the use of dentifrice for 3 months, 8 elderly were classified as normal in the buccal mucosal measurement and 6 were classified normal in the tongue mucosa measurement. Meanwhile, the number of boundary cases decreased markedly in the buccal mucosa measurement, and the participants classified into slightly-dry and moderate dry groups were shifted into boundary or normal groups in the tongue mucosa measurement. The results of the oral mucosal moisture test showed a statistical difference between pre and post intervention.

Figure 5 shows the results of the oral saliva wetness test before and after using the moisturizing dentifrice. Five participants were categorized as slightly-dry and the remaining were categorized as moderate. Three months

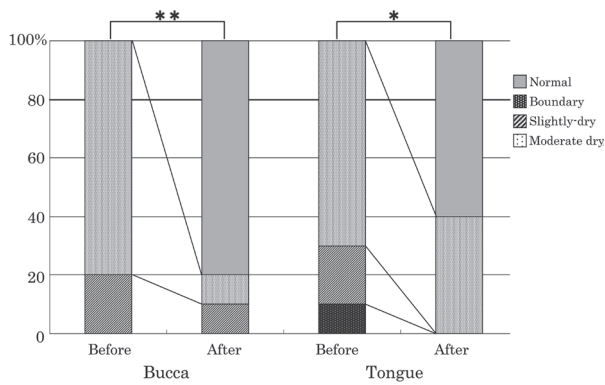


Fig. 4 Change of oral mucosal moisture measurement in 3 months.
 ** $p < 0.05$, ** $p < 0.01$ by chi-squared test.

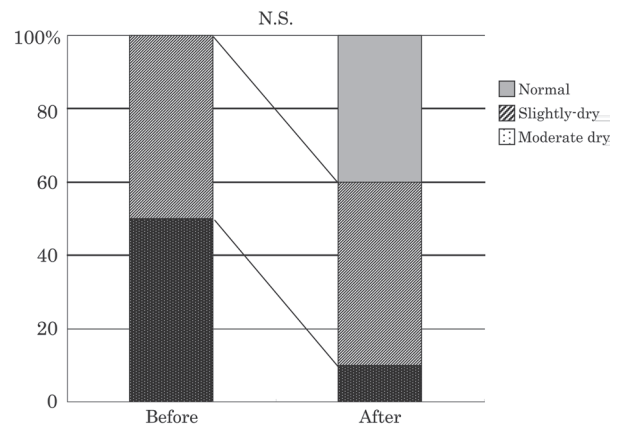


Fig. 5 Change of oral saliva wetness test in 3 months.
 N.S.: not significant by chi-squared test.

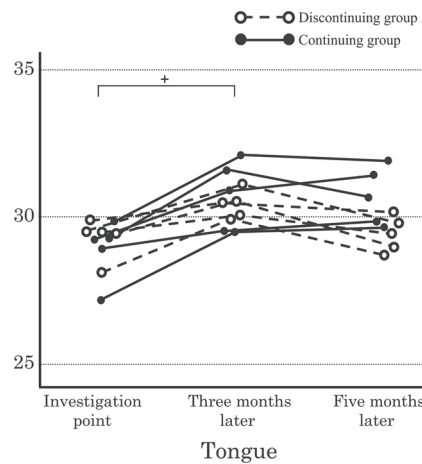
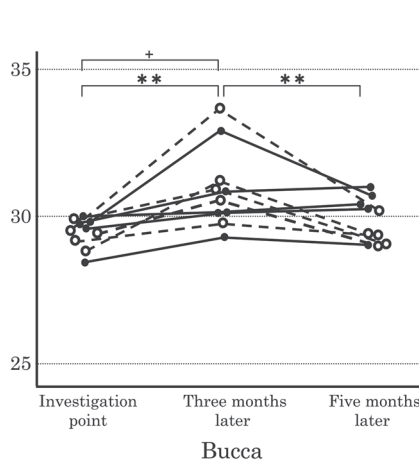


Fig. 6 Change of oral mucosal moisture measurement from beginning of invention to termination.
 ** $p < 0.003$ in discontinuing group, +: $p < 0.0167$ in continuing group, N.S.: not significant by Bonferroni-Dunn test.

later, 4 participants were evaluated normal and the number in the moderate group had decreased. However, there was no significant difference in the changes of the saliva wetness test.

The processes of the oral mucosal moisture measurement and the saliva wetness test of the discontinued and the continuing groups are indicated in Figs. 6 and 7. In the buccal mucosal measurement, all participants who had stopped using the dentifrice reverted to their prior oral conditions five months later. The results of the continuing group showed no significant change in the term between 3 and 5 months; the measurement had increased slightly except for 1 participant whose measurement result had decreased over a period of 2 months. Both results of buccal and tongue mucosa did

not show statistic difference between continuing and discontinuing groups ($F=0.32$ and 0.33 , $p=0.46$ and 0.57 , and respectively). However, the result of buccal mucosa showed statistic difference between investigation point and 3 months later and 3 months later and 5 months later in discontinuing group ($p < 0.01$). Similarly, the results of buccal and tongue mucosa in continuing group showed statistical changes between the investigation point and 3 months later ($p < 0.05$). The changes of the saliva wetness test indicated similar tendency as that of the oral mucosal moisture measurement; on the other hand, there was no significant difference in both of discontinuing and continuing group.

The degree of wetness of 3 participants diminished after stopping the use of the dentifrice, although 1

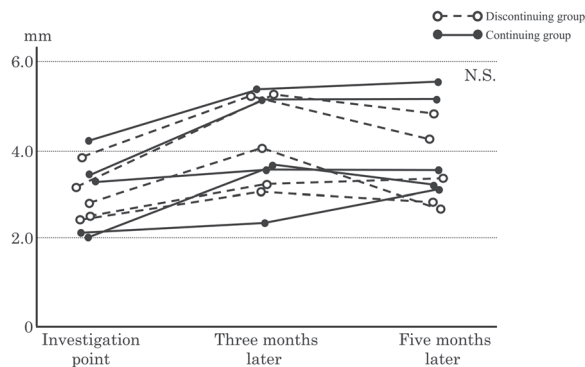


Fig. 7 Change of saliva wetness test from beginning of investigation to termination.
N.S.: not significant by Bonferroni-Dunn test.

participant showed no variation. The results of the remaining 1 participant represented a mild increase of oral wetness over the 2 months. Three subjects in the continuing group showed a slight increase of oral wetness from 3 to 5 months later; however, there was almost no variation for the 2 months. All the comparisons between counting and discounting group and among investigation point, 3 months later and 5 months later did not show any significant differences.

Discussion

In this study changes of oral dryness in elderly females were analyzed, and the effects of oral health care with a moisturizing dentifrice were examined for 5 months. A past researches indicate that a dentifrice with moisturizing agents could ease some subjective and/of objective complaints.¹⁸⁾ Additionally, it has been shown that moisturizing the oral cavity might influence the general physical condition, including fever and amount of food intake.²⁰⁾ The results in this study showed objectively that a moisturizing dentifrice could improve the dryness of the oral mucosa. The oral mucosal moisture measurement used in this study determines the electrostatic capacity to evaluate the amount of water in the epithelium of the mucous membrane.²⁰⁾ Moreover, for people with xerostomia, the sublingual saliva wetness test had a high correlation with spitting method, a way to estimate saliva secretion.²⁴⁾ Consequently, it was considered that these evaluations could accurately measure the amount of

moisture in the oral mucosa.

Some studies have revealed that corneocyte inter-cellular lipids and skin surface lipids play an important role in water conservation mechanisms of the human skin.^{25, 26)} In the oral mucosa little is known regarding the mechanisms of water-holding properties of hyaluronic acid, which has a primary moisturizing role in submucosal and subcutaneous tissues.²⁷⁻²⁹⁾ In females with dry mouth, the level of hyaluronic acid in saliva is markedly lower than that of a normal female group.²⁷⁾ The dentifrice used in this study contains sodium hyaluronate, glycerin and propylene glycol as moistening agents. Our results show that these moisturizing agents in the oral submucosal area promoted a constant level of moisture. The oral moisturizing conditions of the participants were improved for 3 months after beginning oral health care with the dentifrice. However, the beneficial effect for easing oral dryness was temporary and did not last long when the participants stopped using the dentifrice. Moreover, to improve the dryness on the tongue mucosa was harder than the improvement of buccal mucosa unless the dentifrice was used for a long time. This result has also been reported regarding other oral moisturizing products including some kinds of artificial saliva and oral moisturizing liquids.^{16, 17)}

Additionally, a dentifrice available for diminishing oral dryness and soreness of patients with oral cancer also did have a long-lasting effect.^{19, 30)} Some research has shown that oral dryness and xerostomia of the elderly are caused by medication, aging and oral dysfunction.^{12, 13)} In recent years it has become well known that numerous medications might result in dry mouth and oligosialia as adverse drug reactions on one level or another.³¹⁻³³⁾ All participants of this study took daily medications that could bring on oligosialia, and it was, therefore difficult to increase the amount of saliva secretion. Consequently, these results showed that the oral submucosal condition could not be significantly changed even with the use of moisturizing agents.

From these findings, our study suggests that daily oral health care with a dentifrice containing moisturizing

agents can improve the oral mucosal wetness and submucosal moisture condition of the elderly. However, the effect of the moisturizing dentifrice continues as long as the oral moisturizing gel is used and sublingual dryness can be easy to fail to improve.

Multidirectional intervention, including oral health care and the control of drug administration and corresponding primary diseases, may be needed to improve oral dryness in the elderly.

References

- 1) Dawes C: Physiological factors affecting salivary flow rate, oral sugar clearance, and the sensation of dry mouth in man. *J Dent Res*, **66**: 648–653, 1987
- 2) Locker D: Dental status, xerostomia and the oral health-related quality of life of an elderly institutionalized population. *Spec Care Dentist*, **23**: 86–93, 2003
- 3) Turner D, Ship A: Dry mouth and its effects on the oral health of elderly people. *J Am Dent Assoc Suppl*, **138**: 15S–20S, 2007
- 4) Osterberg T, Landahl S, Hedegard B: Salivary flow, saliva, pH and buffering capacity in 70-year-old men and women. Correlation to dental health, dryness in the mouth, disease and drug treatment. *J Oral Rehabil*, **11**: 157–170, 1984
- 5) Pajukoski H, Meurman JH, Halonen P, Sulkava R: Prevalence of subjective dry mouth and burning mouth in hospitalized elderly patients and outpatients in relation to saliva, medication, and systemic diseases. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*, **92**: 641–649, 2001
- 6) Locker D, Matear D, Stephens M, Jokovic A: Oral health-related quality of life of a population of medically compromised elderly people. *Community Dent Health*, **19**: 90–97, 2002
- 7) Kakinoki Y: Xerostomia in aged persons. *Kyushu-Shikagakkai-zasshi*, **60**: 43–50, 2006
- 8) Daniels E, Wu J: Xerostomia-clinical evaluation and treatment in general practice. *J Calif Dent Assoc*, **28**: 933–941, 2000
- 9) Manoussakis N, Georgopoulou C, Zintzaras E, Pyropoulou M, Stavropoulou A, Skopouli N, Moutsopoulos M: Sjögren's syndrome associated with systemic lupus erythematosus: clinical and laboratory profiles and comparison with primary Sjögren's syndrome. *Arthritis Rheum*, **50**: 882–891, 2004
- 10) Mathews A, Kurien T, Scofield H: Oral manifestations of Sjögren's syndrome. *J Dent Res*, **87**: 308–318, 2008
- 11) Fox PC, Bowman J, Segal B, Vivino B, Murukutla N, Choueiri K, Ogale S, McLean L: Oral involvement in primary Sjögren syndrome. *J Am Dent Assoc*, **139**: 1592–1601, 2008
- 12) Baum J: Age-related vulnerability. *Otolaryngol Head Neck Surg*, **106**: 730–732, 1992
- 13) Ship A, Pillemer R, Baum J: Xerostomia and the geriatric patient. *J Am Geriatr Soc*, **50**: 535–543, 2002
- 14) Iga Y, Arisawa H, Ogane N, Saito Y, Tomizuka T, Nakagawa-Yagi Y, Masunaga H, Yasuda H, Miyata N: (±)-cis-2-Methylspiro [1,3-oxathiolane-5, 3'-quinuclidine] hydrochloride hemihydrate (SNI-2011, cevimeline hydrochloride) induces saliva and tear secretions in rats and mice: The role of muscarinic acetylcholine receptors. *Jpn J Pharmacol*, **78**: 373–380, 1998
- 15) Silvestre J, Minguez P, Sune-Negre M: Clinical evaluation of a new artificial saliva in spray form for patients with dry mouth. *Med Oral Patol Oral Cir Bucal*, **14**: E8–E11, 2009
- 16) Regelink G, Vissink A, Reintsema H, Nauta M: Efficacy of a synthetic polymer saliva substitute in reducing oral complaints of patients suffering from irradiation-induced xerostomia. *Quintessence Int*, **29**: 383–388, 1998
- 17) Epstein B, Emerton S, Le D, Stevenson-Moore P: A double-blind crossover trial of oral balance gel and biotene toothpaste versus placebo in patients with xerostomia following radiation therapy. *Oral Oncol*, **35**: 132–137, 1999
- 18) Yamamoto K, Nakagawa T, Tsuyuki M, Hirota A, Kurihara M, Inoue M, Maeda M, Yamakawa N, Kirita T: Efficacy of moisturizing gel in patients with dry mouth. *J Jpn Oral Muco Membr*, **11**: 1–7, 2005
- 19) Nagy K, Urban E, Fazekas O, Thurzo L, Nagy E: Controlled study of lactoperoxidase gel on oral flora and saliva in irradiated patients with oral cancer. *J Craniofac Surg*, **18**: 1157–1164, 2007
- 20) Sudo E, Maejima I: The effects of moisturizing gel to prevent dry mouth in patients with cerebrovascular disease. *Japanese Journal of Geriatrics*, **45**: 196–201, 2008
- 21) Naito H, Ohashi K, Otawa K, Jinbu Y, Kusama M: Study on the moisture of oral mucosa—Difference in the region of the normal oral mucosa—. *J Jpn Oral Muco Membr*, **9**: 50–55, 2003
- 22) Okane M, Kitamura Y, Sato Y, Kitagawa N, Mashimo J: Objective assessment of the subjective sensation of oral dryness. *Japanese Journal of Gerodontology*, **22**: 298–308, 2007
- 23) Takahashi M, Hashimoto Y: Effect of the oral functional exercise in day-care center uses (1)—Baseline study on oral function and QOL—. *Kitakanto Med J*, **59**: 241–246, 2009
- 24) Kakinoki Y: Evaluation of dry mouth in older and disabled persons with saliva wet test. *JJSDH*, **25**: 11–17, 2004
- 25) Imokawa G, Hattori M: A possible function of structural lipids in the water-holding properties of the stratum corneum. *J Invest Dermatol*, **84**: 282–284, 1985
- 26) Imokawa G, Akasaki S, Minematsu Y, Kawai M: Importance of intercellular lipids in water-retention properties of the stratum corneum: induction and recovery study of surfactant dry skin. *Arch Dermatol Res*, **281**: 45–51, 1989
- 27) Bertolami N, Day H, Ellis G: Separation and properties of rabbit buccal mucosal wound hyaluronidase. *J Dent Res*, **65**: 939–944, 1986
- 28) Oksala O, Salo T, Tammi R, Häkkinen L, Jalkanen M, Inki P, Larjava H: Expression of proteoglycans and hyaluronan during wound healing. *J Histochem Cytochem*, **43**: 125–135, 1995

- 29) Higuchi Y, Ansai T, Awano S, Soh I, Yoshida A, Hamasaki T, Kakinoki Y, Takehara T: Salivary levels of hyaluronic acid in female patients with dry mouth compared with age-matched controls: a pilot study. *Biomed Res*, **30**: 63–68, 2009
- 30) Cassolato S, Turnbull R: Xerostomia. Clinical aspects and treatment. *Gerodontology*, **20**: 64–77, 2003
- 31) Charalampous D, Keepers A: Major side effects of antipsychotic drugs. *J Fam Pract*, **6**: 993–1002, 1978
- 32) Walls W, Steele G: The relationship between oral health and nutrition in older people. *Mech Ageing Dev*, **125**: 853–857, 2004
- 33) Uher R, Farmer A, Henigsberg N, Rietschel M, Mors O, Maier W, Kozel D, Hauser J, Souery D, Placentino A, Strohmaier J, Perroud N, Zobel A, Rajewska-Rager A, Dernovsek Z, Larsen R, Kalember P, Giovannini C, Barreto M, McGuffin P, Aitchison J: Adverse reactions to antidepressants. *Br J Psychiatry*, **195**: 202–210, 2009