PREVALENCE OF ALTERED TASTE AMONG THE ELDERLY IN BANGKOK, THAILAND

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Abstract. Taste disorders and reduce salivary flow rates may be more common among the elderly possibly leading to loss of appetite, weight loss and nutritional deficiencies. There is limited data regarding the prevalence of taste disorders and reduce salivary flow among elderly Thais. In this study we aimed to determine the prevalence of taste disorders among elderly Thais and if they have an association with salivary flow rate in order to better understand the epidemiology of this condition in the study population. Study subjects were those aged ≥60 years who lived in Bangkok, Thailand during June 2019-February 2021, were not current smokers and were willing to participate in the study. The subjects were randomly selected from those who responded to an announcement about our study made at the Faculty of Dentistry, Mahidol University and Maha Chakri Sirinthorn Dental Hospital. The minimum number of study subjects calculated to be needed for the study was 62. In each subject, the stimulated salivary flow rate was measured and the perception of sweet, salty, sour, bitter and monosodium glutamate taste were tested using a filter-paper-disc method (FPD). A total of 70 subjects were included in the study; 77% female. The mean (± standard deviation) age of subjects was 67 (± 5) (range: 60-78) years. Twenty-three percent of subjects (n = 16) had a reduced salivary flow rate (defined as <0.7 ml/min). Eighty-one percent (n = 57) had an altered taste: 23% (n = 16) could not taste sweet, 20% (n = 14) could not taste salty, 16% (n = 11) could not taste sour, 6% (n = 4) could not taste bitter and 77% (n = 54) could not taste monosodium glutamate. There was no significant association between the salivary flow rate and altered taste perception (p = 0.766). In summary, the prevalence of altered taste among study subjects was high, especially the taste of monosodium glutamate, but was not significantly associated with a reduced salivary flow rate. We conclude healthy elderly Thais may have a high prevalence of a taste disorder, especially to monosodium glutamate.

Keywords: taste alteration, Thai population, old person, dysgeusia, taste test, monosodium glutamate

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INTRODUCTION

The worldwide proportion of elderly is increasing (United Nations, 2019). It is estimated by 2040 the number of Thais aged >60 years in Thailand will be 20.5 million out of a total estimated population of 65.4 million (Prasertkul *et al*, 2021).

Food enjoyment depends partly on taste (Sasano *et al*, 2012; Boyce and Shone, 2006). Impaired taste perception is more common in the elderly and may result from normal ageing or from disease, such as Alzheimer's disease, medication side-effects, surgical procedures and environmental exposures. Impaired taste perception in the elderly may affect appetite and cause nutritional deficiencies (Schiffman and Graham, 2000).

Although it has been reported that the taste and smell sensory systems deteriorate when people get older, in many cases, what is perceived as a taste defect is really a primary defect in olfaction (Boyce and Shone, 2006). The alteration of taste sensation itself may occur due to a change in receptor cells on the taste buds. Typically, chemical compounds from food activate taste receptors on the taste buds, producing the perception of salty, sweet, sour, bitter or monosodium glutamate (monosodium glutamate, MSG) depending on the flavor (Risso *et al*, 2020). Food culture may also play a part in taste perception (Trachootham *et al*, 2018).

Altered taste perception may be a decreased perception of taste (hypogeusia), absence of taste perception (ageusia) or distorted taste perception (dysgeusia) (Schiffman and Graham, 2000; Kershaw and Mattes, 2018).

Saliva is important for taste perception because it dilutes taste substances and transports them to the taste receptors. Saliva protects the taste receptors from drying out and becoming infected. Saliva can also influence taste sensitivity (Ambaldhage *et al*, 2014). Normal salivary flow is 1-2 ml/min, while <0.7 ml/min is considered abnormally low (Miranda-Rius *et al*, 2015).

A study from Japan, reported the prevalence of abnormal taste perception in the elderly to be 36.6% (Sasano *et al*, 2012), a study from the

United States reported it to be 17.3% (Liu *et al*, 2016) and another study from the United States reported it to be 5.1% (Imoscopi *et al*, 2012).

There are no previous published studies of the prevalence of altered taste in the healthy elderly in Thailand. In the present study we aimed to determine the prevalence of a taste disorder among elderly Thais in Bangkok, Thailand and if there is a significant association between altered taste and a low salivary flow rate.

MATERIALS AND METHODS

Subjects

Study subjects were Thais aged ≥60 years who lived in Bangkok, had no history of a systemic disease, were not taking medication and did not have a history of altered taste perception or reduced salivary flow in the previous month. Those with communication problems, having dental treatment in the previous 6 months, having a history of cancer, who were smokers or had a history of allergy to any of the test materials were excluded from the study.

An announcement requesting volunteer subjects was made at the Faculty of Dentistry, Mahidol University and at the Maha Chakri Sirinthorn Dental Hospital. All subjects, who met the above inclusion criteria and wanted to join the study, were included in the study.

This prospective study was conducted during June 2019-February 2021. The sample size was calculated using n4Studies (https://pcmac.download/app/680516901/n4studies). The expected proportion was based on a previous study from Japan that reported the prevalence of taste deficiency to be 36.6% (Sasano *et al*, 2012). We used a confidence level of 95%and a margin of error of 10%, the minimum sample size required for the study was calculated to be 62. We rounded this number up to 70 to take into account missing data and other errors.

Questionnaire and saliva collection

Each subject was asked to complete a questionnaire asking about food preferences and eating and cooking habits. Each subject was asked to refrain from eating, drinking, smoking or brushing their teeth for at least 1 hour prior to the test. Each subject was asked to chew a 1-cm3 piece of paraffin for 5 minutes to stimulate saliva production; the saliva secreted while chewing was collected in a test tube and the volume was measured.

Taste testing

Taste perception was conducted by a dentist. The ability to taste sweet, sour, salty and bitter was determined using a filter-paper-disc (FPD) taste test kit (Taste Disc®, Sanwa Chemical

Laboratory Inc, Nagoya, Japan); each taste was tested at 5 concentrations (Table 1). Five-millimeter diameter filter paper discs were used to assess the ability to taste MSG (Ajinomoto Co Ltd (Thailand)) at 6 concentrations of 1, 5, 10, 50, 100, and 200 mM, as previously described (Satoh-Kuriwada *et al*, 2014). The filter-paper discs were placed on the tip of the tongue, on the base of the tongue and on the soft palate for 3 seconds in each subject with their mouth open. The test was conducted starting from the lowest concentration and increasing in concentration with each tested disc. The mouth test sites were chosen because they are each supplied by a different nerve: the chorda tympani branch of the facial nerve, the glossopharyngeal nerve and the greater petrosal nerve.

Increasing concentrations of each taste were tried until the subject was able to perceive the taste. A score was given indicating the number of the disc at which the subject was finally able to detect the taste. If the subject was unable to detect the taste, the score for the last disc number +1 was given. Each subject rinsed their mouth with 20 ml distilled water between each concentration to eliminate any remaining taste from the previous disc. We defined recognition threshold (RT) as the concentration at which the taste could be recognized correctly twice. A normal RT score for our study was set at <3 and a deficient taste perception (hypogeusia), was set at a score of ≥4.

Statistical analysis

The Statistical Package for Social Sciences (SPSS) for Windows, version 18.0 (SPSS Inc, Chicago, IL) was used for statistical analysis. Descriptive statistics were used for data analysis. The Pearson chi-square test was used to determine the association between salivary flow rate and taste perception. Significance was defined as $p<0.05$.

Ethical considerations

This study was approved by Faculty of Dentistry/Faculty of Pharmacy, Mahidol University, Institutional Review Board COA No. MU-DT/PY-IRB 2019/076.0811. Informed consent was obtained from each subject prior to being included in this study.

RESULTS

A total of 70 subjects were included in the study, 77% female ($n = 54$). The mean (± standard deviation) age of subjects was 67 (± 5) (range: 60-78) years. No subjects were current smokers, 7 were former smokers and 63 had never smoked. Fifty-seven subjects (81%) had hypogeusia, of whom 44 (77%) were female (Fig 1).

Twenty-three percent of subjects ($n = 16$) could not perceive sweet, 16% ($n = 11$) could not perceive sour, 20% ($n = 14$) could not perceive salty, 6%

Table 1

Concentration of studies tastes

Recognition threshold score	Concentration of studied test (gram/100 ml)				
	Sweet (Sucrose)	Salty (NaCl)	Sour (Tartaric acid)	Bitter (Quinine hydrochloride)	Monosodium glutamate (MSG)
1	0.3	0.3	0.02	0.001	0.0187
2	2.5	1.25	0.2	0.02	0.0935
3	10	5	2	0.1	0.187
4	20	10	4	0.5	0.935
5	80	20	8	4	1.87
6	*	*	*	*	3.74
7					*

*If the subject was unable to detect the taste despite the highest concentration, a score of the last disc number +1 was assigned.

ml: milliliter; MSG: monosodium glutamate; NaCl: sodium chloride

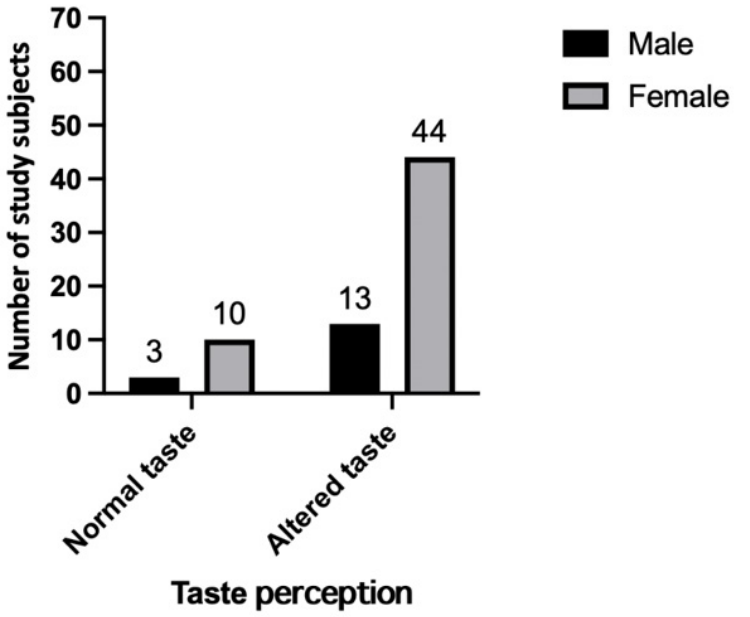

Fig 1 - Sex distribution of study subjects with normal and altered taste perception

(*n* = 4) could not perceive bitter and 77% (*n* = 54) could not perceive MSG flavor (Table 2).

MSG had the highest mean perception threshold (5.91), followed by sweet (4.33), sour (4.05), salty (3.68) and bitter (3.36) (Fig 2).

The tested site with the greatest reduction in taste perception was the tip of tongue; 89% of subjects (*n* = 62) were unable to taste MST, 60% (*n* = 42) were unable to taste sweet, 53% (*n* = 37) were unable to taste salty, 40% (*n* = 28) were unable to taste bitter and 26% (*n* = 37%) were unable to taste sour (Fig 3). At the tongue base 84% of subjects (*n* = 59) could not taste MSG, 36% (*n* = 25) could not taste salty, 33% (*n* = 23) could not taste sweet, 26% (*n* = 18) could not taste sour and 11% (*n* = 8) could not taste bitter (Fig 4). On the soft palate 84% (*n* = 59) could not taste MSG, 53% (*n* = 37) could not taste sweet, 53% (*n* = 37) could not taste salty, 47% (*n* = 33) could not taste sour and 36% (*n* = 25) could not taste bitter (Fig 5).

Twenty-three percent of study subjects (*n* = 16) had a reduced salivary flow rate (<0.7 ml/min) (Fig 6). One subject had a flow <0.01 ml/minute. No significant association was found between a reduced saliva flow rate and altered taste (*p* = 0.76).

DISCUSSION

The prevalence of hypogeusia in our study was 81%, much higher than the 36.6% reported by a similar study from Japan (Sasano *et al*, 2012) and the 17.3% reported in a study from the United States (Liu *et al*, 2016). Our study and the study from Japan mentioned above used the same test kit while the study from the United States used a different method, which could explain some of the differences between the studies. Another possible reason for the different prevalences in hypogeusia could be differences in food culture in the various study populations. Thai people prefer spicy food which can affect their perception of the various tastes tested (Trachootham *et al*, 2018).

In our study, we found no significant association between reduced salivary flow rates and hypogeusia, unlike the findings of a

Table 2

Taste perception among study subjects (N = 70)

Taste and status	*n* (%)	Sex, *n* (%)	
		Male	Female
Sweet			
Normal	54 (77)	12 (17)	42 (60)
Altered	16 (23)	4 (6)	12 (17)
Sour			
Normal	59 (84)	16 (23)	43 (61)
Altered	11 (16)	0 (0)	11 (16)
Salty			
Normal	56 (80)	13 (19)	43 (61)
Altered	14 (20)	3 (40)	11 (16)
Bitter			
Normal	66 (94)	15 (22)	51 (73)
Altered	4 (6)	1 (1)	3 (4)
Monosodium glutamate			
Normal	16 (23)	4 (6)	12 (17)
Altered	54 (77)	12 (17)	42 (60)

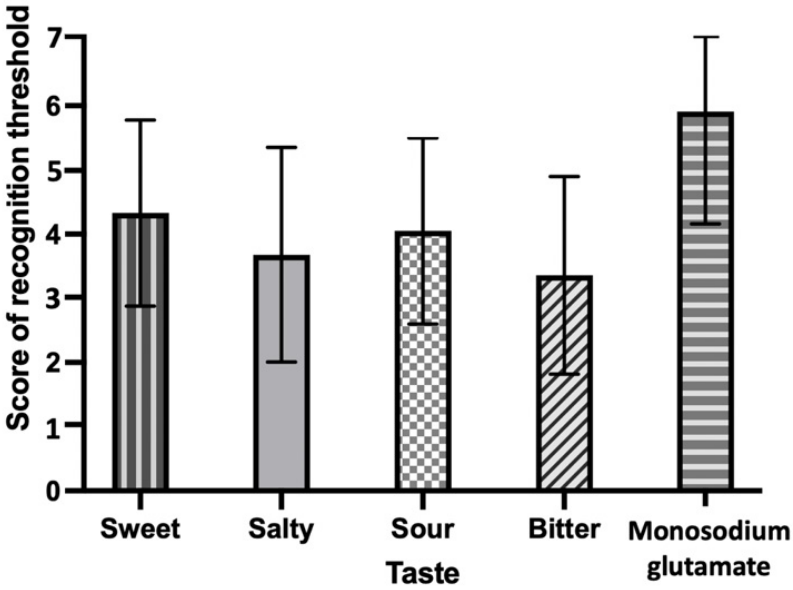

Fig 2 - Taste perception recognition thresholds among study subjects

Note: The recognition threshold is the lowest concentration at which the taste can be perceived. A normal recognition threshold was considered to be a score <3.

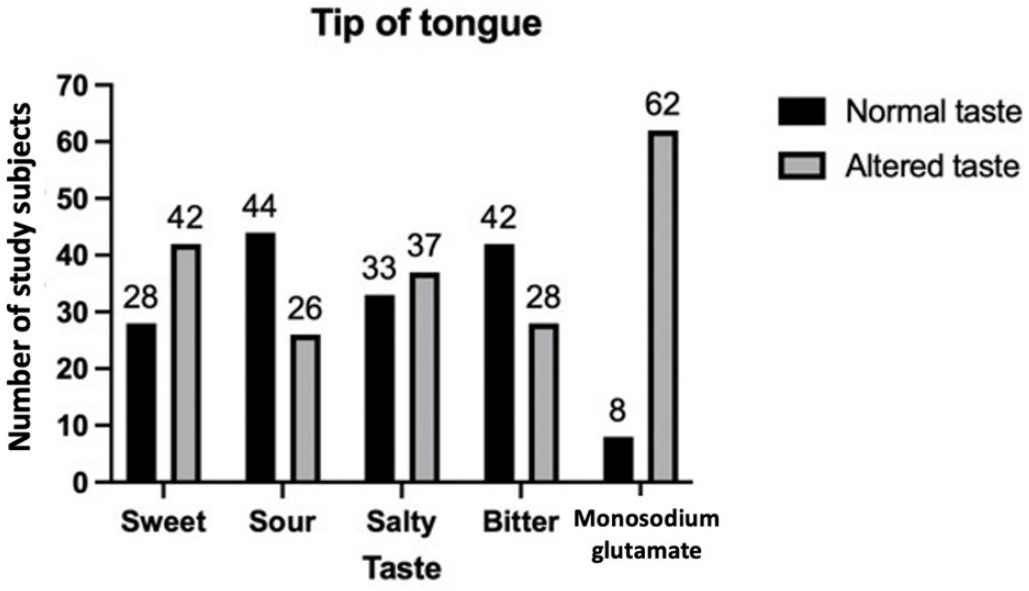

Fig 3 - Taste perception on the tip of the tongue by taste

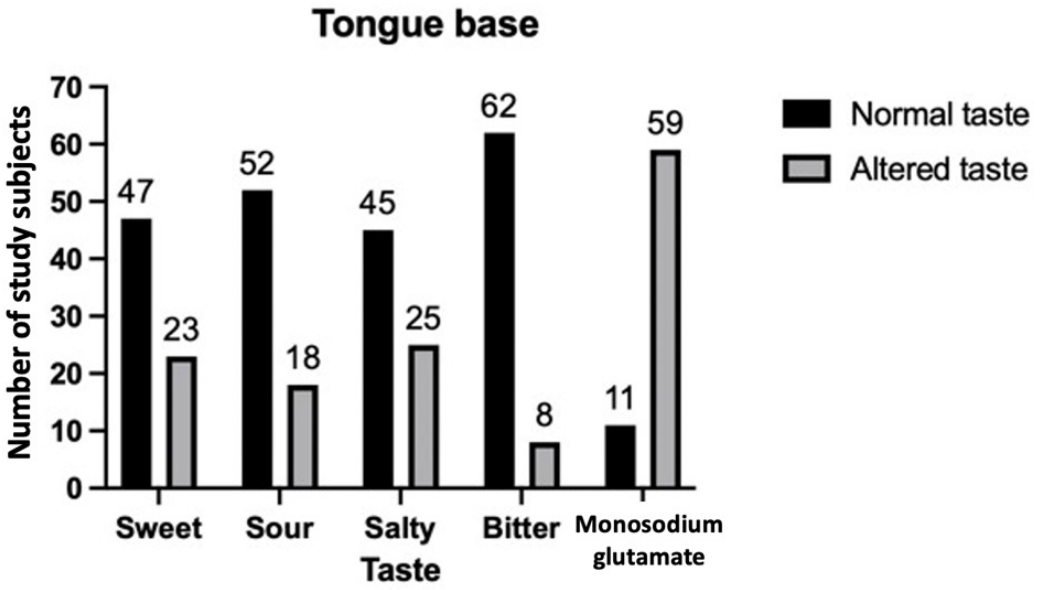

Fig 4 - Taste perception at the base of the tongue by taste

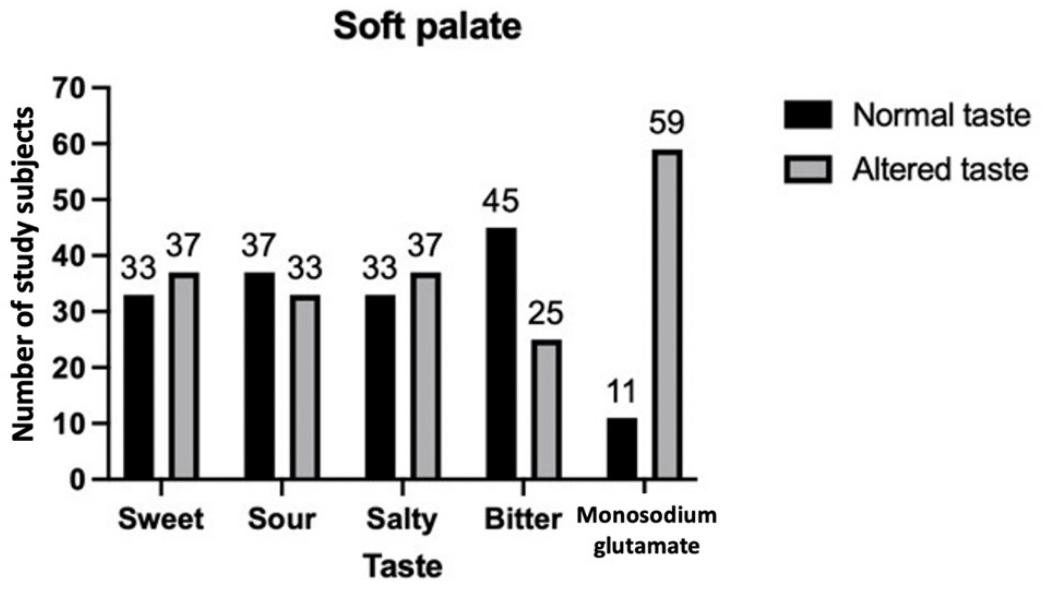

Fig 5 - Taste perception on the soft palate by taste

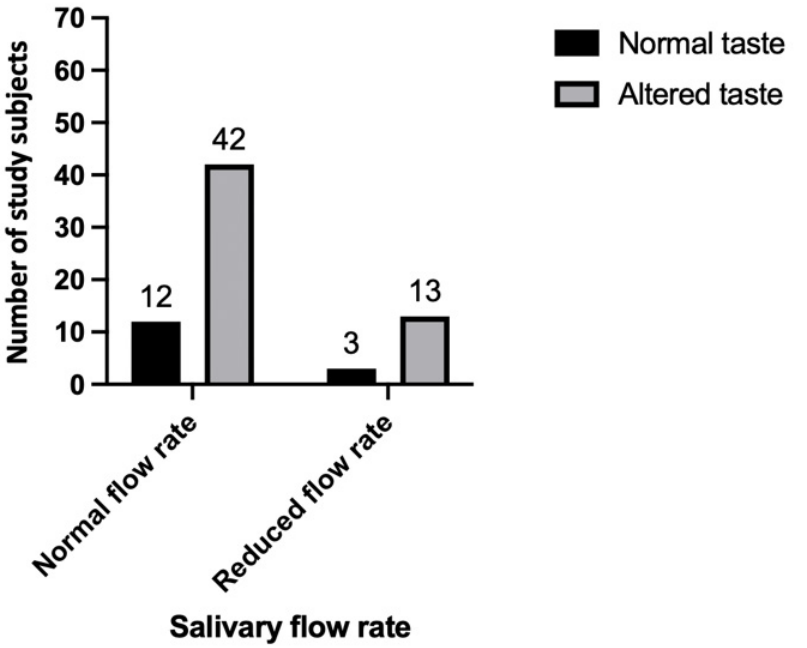

Fig 6 - Salivary flow rates among subjects with normal taste and altered taste perception
Note: A normal salivary flow rate is ≥1 milliliter per minute.

study from Japan (Sasano *et al*, 2012). This difference could be due to other differences, such as differences in oral hygiene (Madiloggovit *et al*, 2016) or food culture (Trachootham *et al*, 2018).

Based on our results, we hypothesized the normal taste threshold for Thais might be higher than 3 used for our study results above so we recalculated the prevalence of hypogeusia in our study population using a cutoff point of 4, giving a prevalence of hypogeusia in our study population of 60% (n = 31), which is still higher than other studies (Sasano *et al*, 2012; Liu *et al*, 2016). With this adjusted cut-off point we still found no significant association between a reduced salivary flow rate and hypogeusia (p = 0.416).

In our study, all three parts of the mouth tested showed MSG was the flavor with the greatest prevalence of hypogeusia similar to a study from Thailand and Japan (Trachootham *et al*, 2018). Most of our elderly subjects knew what MSG is, but most did not know what it tastes like.

This could be the main reason for the high prevalence of hypogeusia overall and for perception of MSG specifically.

Since we only selected healthy elderly volunteers, our result may not reflect the true prevalence of hypogeusia among elderly Thais in general. Future studies should determine the prevalence of hypogeusia among elderly Thais with an underlying disease, sampling various parts of Thailand.

In summary, the prevalence of hypogeusia in our study population was high but was not associated with reduced salivary flow. Caregivers of the study population need to take this into consideration and alter the flavor profile to improve taste perception in order to reduce the risk of nutritional deficiencies in the study population and improve their quality of life.

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REFERENCES

Ambaldhage VK, Puttabuddi JH, Nunsavath PN, Tummuru YR. Taste disorders: a review. *J Indian Acad Oral Med Radiol* 2014; 26: 69-76.

Boyce JM, Shone GR. Effects of ageing on smell and taste. *Postgrad Med J* 2006; 82: 239-41.

Imoscopi A, Inelmen AE, Sergi G, Miotto F, Manzato E. Taste loss in the elderly: epidemiology, causes and consequences. *Aging Clin Exp Res* 2012; 24: 570- 9.

Kershaw JC, Mattes RD. Nutrition and taste and smell dysfunction. *World J Otorhinolaryngol Head Neck Surg* 2018; 4: 3-10.

Liu G, Zong G, Doty RL, Sun Q. Prevalence and risk factors of taste and smell impairment in a nationwide representative sample of the US population: a cross-sectional study. *BMJ Open* 2016; 6: e013246.

Madiloggovit J, Chotechuang N, Trachootham D. Impact of self-tongue brushing on taste perception in Thai older adults: a pilot study. *Geriatr Nurs* 2016; 37: 128-36.

Miranda-Rius J, Brunet-Llobet L, Lahor-Soler E, Farré M. Salivary secretory disorders, inducing drugs, and clinical management. *Int J Med Sci* 2015; 12: 811-24.

Prasertkul P, Damrikarnlerd L, Aruntippaitune S, *et al*. Situation of the Thai elderly 2020, 2021 [cited 2022 Mar 09]. Available from: URL: https://ipsr.mahidol.ac.th/wp-content/uploads/2022/03/Report-File-660.pdf [in Thai]

Risso D, Drayna D, Morini G. Alteration, reduction and taste loss: main causes and potential implications on dietary habits. *Nutrients* 2020; 12: 3284

Sasano T, Satoh-Kuriwada S, Kaneta N, Shoji N, Kawai M, Uneyama H. Incidence of taste disorder and umami taste disorder among the Japanese elderly and youth, 2012 [cited 2022 Mar 09]. Available from: URL: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.825.5426&rep=rep1&type=pdf

Satoh-Kuriwada S, Kawai M, Iikubo M, *et al*. Development of an umami taste sensitivity test and its clinical use. *PloS One* 2014; 9; e95177.

Schiffman SS, Graham BG. Taste and smell perception affect appetite and immunity in the elderly. *Eur J Clin Nutr* 2000; 54 (Suppl 3): S54-63.

Trachootham D, Satoh-Kuriwada S, Lam-Ubol A, *et al*. Differences in taste perception and spicy preference: a Thai-Japanese cross-cultural study. *Chem Senses* 2018; 43: 65-74.

United Nations. World population ageing 2019: Highlights, 2019 [cited 2022 Mar 09]. Available from: URL: https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf