

## Assessment of taste perception disorders in the elderly

# Ocena zaburzeń percepcji smaku u osób w wieku podeszłym

Michał Gośliński<sup>1</sup>, Dariusz Nowak<sup>1</sup>, Marta Ronkiewicz<sup>1</sup>, Alina Jaroch<sup>1,2</sup>

<sup>1</sup> Department of Nutrition and Dietetics, Faculty of Health Sciences, Ludwik Rydygier Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Toruń, Poland

<sup>2</sup> Department and Clinic of Geriatrics, Faculty of Health Sciences, Ludwik Rydygier Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Toruń, Poland

### Abstract

**Background.** The elderly encounter many health problems, including senses disorders. With age, taste and smell are gradually weakened, which has a significant impact on the quality of life. **Aim.** The main objective of this study was the evaluation of taste perception disorders in the elderly. **Materials and methods.** Study participants were divided into two groups: the experimental group (elderly  $\geq 65$  years old) and the control group (healthy adults aged 20-45 years old). The study was conducted in two stages: 1) flavor daltonism test, 2) triangular test. **Results and discussion.** The elderly had trouble identifying four basic flavors, especially the bitter taste (only about 30%) and the salt taste (less than half). In the control group the identification of basic tastes was generally correct. The ability to recognize the difference in stimulus intensity for the sweet taste was a great problem for the elderly, irrespectively of the difference threshold. Literature data confirms that the sensitivity thresholds for all four flavors increase among the elderly. **Conclusions.** Disorders in taste perception are a common phenomenon among the elderly, significantly deteriorating their quality of life. A decrease in taste sensitivity was observed, in particular for the bitter and salty taste, and to a lesser extent for sweet and sour. Taste dysfunction in the elderly can be an important factor in the development of eating disorders and consequently lead to a deterioration of health. (Gerontol Pol 2019; 27; 119-123)

**Key words:** sensory perception, flavor, elderly, taste disorders

### Streszczenie

**Wstęp.** Osoby w wieku podeszłym zmagają się z wieloma problemami zdrowotnymi, dotyczy to również zmysłów. Wraz z wiekiem smak i węch ulegają stopniowemu osłabieniu, co znacząco wpływa na jakość życia. **Cel pracy.** Głównym celem pracy była ocena zaburzeń percepcji smaku u osób w wieku podeszłym. **Materiały i metody.** Uczestników podzielono na dwie grupy: badaną (osoby starsze w wieku  $\geq 65$  lat) i kontrolną (zdrowi dorośli w wieku 20-45 lat). Badanie przeprowadzono w dwóch etapach: 1) test na daltonizmu smakowy; 2) próba trójkątowa. **Wyniki i dyskusja.** Osoby w wieku podeszłym miały problem z rozpoznaniem 4 podstawowych smaków, szczególnie gorzkiego (tylko około 30%) i słonego (mniej niż połowa). W grupie kontrolnej identyfikacja podstawowych smaków była prawidłowa. Zdolność rozpoznawania różnicy natężenia bodźców dla smaku słodkiego była dużym problemem dla osób starszych, niezależnie od zastosowanego progu różnicy. Dane literaturowe potwierdzają, że wśród osób starszych wzrastają progi rozpoznania dla wszystkich czterech smaków. **Wnioski.** Zaburzenia percepcji smaku są powszechnym zjawiskiem wśród osób w wieku podeszłym, istotnie pogarszającym ich jakość życia. Zaobserwowano obniżenie wrażliwości smakowej, w szczególności smaku gorzkiego i słonego oraz w mniejszym stopniu słodkiego i kwaśnego. Dysfunkcja zmysłu smaku u osób w wieku podeszłym może stanowić istotny czynnik zaburzeń odżywiania i w konsekwencji prowadzić do pogorszenia stanu zdrowia. (Gerontol Pol 2019; 27; 119-123)

**Słowa kluczowe:** percepcja sensoryczna, smak, osoby starsze, zaburzenia smaku

## Introduction

Elderly people encounter many problems resulting from a deterioration of their health status. In the process of aging occur changes affecting functioning of all organs, including the sense organs. Problems with vision and hearing are the most common and have the quickest manifestations. Studies also indicate that more than half of people over 80 years old suffer from severe smell disorders. Taste disturbances are relatively rare, but they still involve a large part of the aging population and have a significant impact on the quality of life [1].

Taste is one of the basic senses, responsible for identifying chemical stimuli. Taste and smell are of the utmost importance in receiving taste sensation. Commonly taste is associated with nutrition and allows direct analysis of the food composition. Often, taste is perceived as a factor important in the acceptance of food products or meals, and therefore the sensitivity and efficiency of the senses strongly influence the way of eating and the choice of food products. As the research shows, there is a strong correlation between taste sensitivity and individual nutritional preferences [2]. We differentiate four basic tastes: sweet, salty, sour and bitter. In the last few years a fifth taste called umami was identified, described as a meat-broth taste typical for Asian dishes [3]. Taste and smell are gradually weakening with age. Among seniors over 60 years old noticeable changes in stimulus reception are observed. One of the first researchers interested in the problem of taste disorders among the elderly was R. Cooper [4]. The issue was continued in the 1980s and even nowadays still attracts the interest of many researchers. For example, Japanese researchers analyzed the incidence of taste disorders in over two thousand people, and obtained an average of 13%. A correlation between sense of taste and other sensory disorders was also observed. Only 5.4% of the patients had solely taste disturbances, and as many as 75% of the patients had problems with taste and smell [5].

Impairment of taste and smell negatively affect overall health and well-being, especially if we take into consideration an elderly person with many health problems. In a lifetime, the number of taste buds can reduce by more than half. Moreover, their size decreases, thereby reducing the taste sensitivity, simultaneously increasing the sensitivity threshold for flavors. Impaired reception of sweet, salty and bitter stimulants begins after the age of 50, while for sour taste visible changes in sensory perception begin over 60 years old [6-8]. Elevated recognition thresholds for sucrose or sodium chloride can manifest a dysfunction in sensing taste in the elderly. This may negatively affect the way of eating by changing die-

tary preferences, which are characterized by an excessive consumption of food additives, in the form of salt or sugar [9]. Among the elderly, a growing problem of obesity, or malnutrition was noted, as a result of observation of health and nutritional status. Often there is a reluctance to eat meals as well as the appetite weakens. This leads to a decrease in dietary energy intake and an increased risk of quantitative and qualitative deficiencies. People with sensory disorders had some specific nutritional behaviors. Reduction in the perception of taste and smell stimulus promotes lower consumption of vegetables and fruits rich in vitamins A and C. There was a general disinclination for bitter and sour food products and no pleasure in preparing and consuming meals. The diet largely contained sweets, and most menus were poor in vitamin D and E, and also zinc, an important factor in sensing taste [8,10].

For most people consuming food is associated with a strong sense of pleasure. Sensory perception disorders can promote the development of abnormalities in the way of eating. General practitioners often underestimate this problem, which can lead to discomfort and consequently to significant eating disorders among the elderly [1,9].

In view of the above, the main objective of this study was evaluation of taste perception disorders in the elderly.

## Materials and methods

Before starting the study, consent from the local Bioethics Committee working at Collegium Medicum Nicolaus Copernicus University in Toruń, Poland was granted (No. 238/2015). Elderly people volunteered to participate in the study. As required, the participants were informed about the purpose and methodology of the research and were required to give their written consent for participation in the study. The study provided anonymity and selection was random.

Study participants were divided into two groups: experimental and control. 24 elderly people (19 women, 5 men) were qualified into the experimental group according to age criteria developed by the WHO ( $\geq 65$  years old). Mean age in this group was 74.1 years. Elderly qualified into this group were patients-bathers of the Social Assistance House "Radiant of Life" in Bydgoszcz and patients of the Clinic of Geriatrics, University Hospital No. 1 in Bydgoszcz. The control group consisted of 17 healthy adults (10 women, 7 men), aged 20-45 years old (mean age 35.3), who were employees of the Social Assistance House "Radiant of Life".

The study was conducted in two stages: 1) assessing the ability to proper flavors identification – flavor daltonism test; 2) ability to recognize the difference in the stimulus intensity – triangular test. In the first stage, natural substances representing 4 basic flavors were used: sweet (sucrose), salty (sodium chloride), sour (citric acid) and bitter (caffeine) [2,9]. Each study participant received an individual set of samples. All samples for taste evaluation were marked with a three-digit code, known only by the researchers. The sample codes were selected on the basis of a random number table. Participants tasted the solutions in a fixed order, distributing the sample volume throughout the whole oral cavity. Results of the evaluation were recorded in the response cards.

In the second stage of the study, a triangular test for sweet taste was performed. This taste was chosen due to a possible influence on diet and health consequences associated with excess sugar consumption. Moreover, the test was not conducted for three other tastes, because of reported by the elderly discomfort in participating in a whole cycle of tests and a possible occurrence of the so-called sensory fatigue. Participants received 6 sets, each consisting of 3 samples, two of which were identical, and the third was different in terms of the intensity of the stimulus (higher or lower sweetness). Study participant had to taste and point out the different sample and write down the result on the answer card [2,9].

Statistical analysis was made using the Microsoft Excel data analysis tools.

## Results

In the first stage of the study, flavor daltonism test allowed to evaluate which of the four basic tastes age-related taste perception was most affected (Figure 1). In the experimental group, elderly people had trouble identifying bitter taste – only about 30% of people correctly recognized this taste. Less than half of the elderly were able to properly identify salty taste. Samples with sweet taste and pure water correctly deciphered more than half of the respondents. The greatest ease was observed in the identification of sour taste, which properly recognized over 70% of the study participants. In the control group the identification of basic tastes was generally correct, the average identification coefficient was 84%, and the lowest score was obtained for the bitter taste (73%).

The second criterion used to interpret the results was gender of the respondents, and both groups were analyzed. Based on the obtained data, it was possible to determine whether the ability to identify tastes was determined by gender (Figure 2). Detection of taste in the

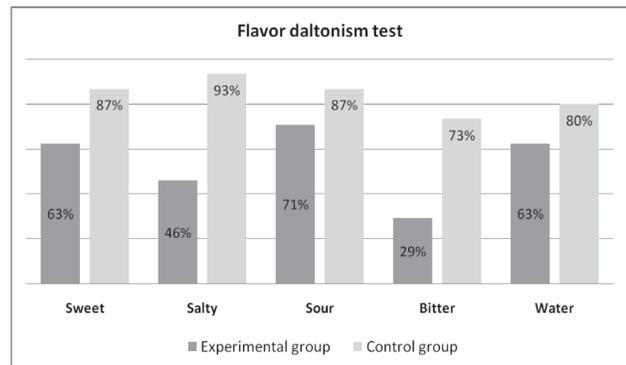


Figure 1. Results of the flavor daltonism test

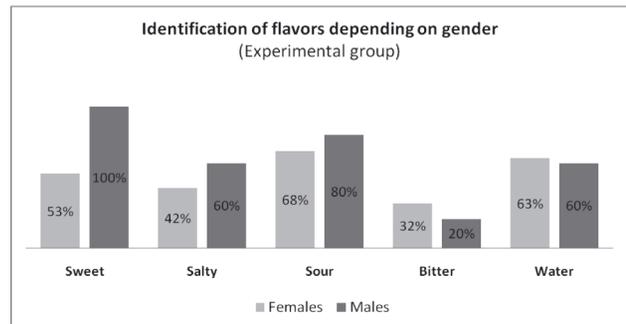


Figure 2. Identification of flavors depending on gender (experimental group)

control group, depending on gender, was not statistically significant ( $p = 0.05$ ).

Comparing the results for both genders, it was found that males had better sensitivity for sweet, salty and sour tastes, while women had the ease to indicate bitter taste. Identification of pure water showed no statistical significance. For sensory sensitivity of sweet and salty taste the difference between genders was statistically significant (Figure 2).

In the second stage of the study, the ability to recognize the difference in stimulus intensity for sweet taste was evaluated using the triangular method. Two difference thresholds were used: 0.2 and 0.8 g of sucrose per 100 mL of solution. Results are presented on Figure 3. Recognition of the lower sweetness intensity was a great problem for the elderly (only 17% of correct answers). In the control group nearly 1 of the participants had no problem with identifying the distinct sample in the triangular set. However, in the case of a higher threshold difference for sweet taste (0.8 g sucrose per 100 mL) better results were noted (42%), but still more than half of the elderly were unable to correctly identify the distinct sample. In the control group, identification of the higher sweetness intensity difference was not a problem for nearly 90% of the subjects.

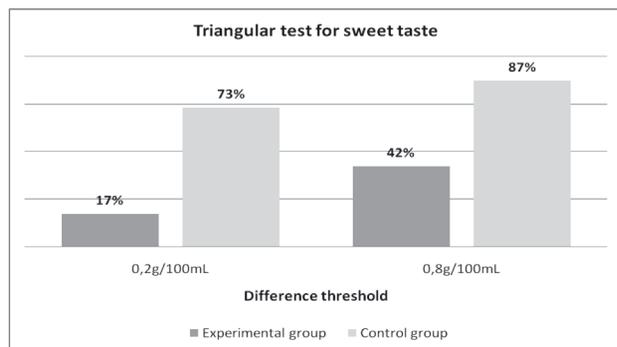


Figure 3. Results of the triangular test for sweet taste

## Discussion

Tests conducted in this paper indicate that the sense of taste reduced in older age. Literature confirms this finding, but the mechanism of loss or weakening of the sense of taste is less known. It is assumed that zinc deficiency may have an important role in this process. Zinc causes hyperkeratinization of the epithelial cells, and moreover is a cofactor of gustin – a protein found in taste receptors. Another etiological factor may be vitamin deficiencies, such as B<sub>12</sub> and folic acid, which impair the regeneration of taste cells. However, the main cause of taste disturbances is considered to be the change in the taste organ itself and the age-related neurological changes [6-8].

Fukunaga et al. conducted a study on age related changes in the perception of four basic tastes. It demonstrated that among the elderly the thresholds for the diagnosis of all four flavors increases. The greatest divergences concerned the recognition and detection thresholds for quinine (bitter taste), and sodium chloride (salty taste). To a lesser extent, but equally important, were the divergences for sucrose and tartaric acid (sweet and sour taste respectively). Also in our study, it was confirmed that the greatest issue was the correct identification of bitter and salty taste and, to a lesser extent, sweet and sour. According to Fukunaga et al., the cause of taste perception disorders is not merely the decrease in the number of taste buds with aging, but as the research shows, the disturbance of taste receptors renewal [11].

Our research showed that women could better identify the bitter taste, especially in older age. Sensitivity to bitterness, both in men and in women, develops gradually to the age of 16-20 years old. It is also assumed that women are more sensitive to bitterness from early childhood till adolescence. Later, the bitterness thresholds are almost equal for both women and men. In the aging process it decreases faster in men than in women [12]. In addition, the sensitivity to bitter taste is considerably reduced among the elderly in comparison to younger pe-

ople [13-15]. These findings were confirmed in our study – correct identification of bitter taste in the experimental and control group was 29% and 73%, respectively.

There was a significant difference in the perception of salty taste between the study groups (43:90%). Other studies also confirmed the increased sensitivity thresholds for salty taste in old age, moreover, sensitivity reduction was not only related to sodium chloride but also to other salts of flavor compounds [11,14]. In studies concerning eating preferences of the elderly, a three-fold higher consumption of sodium chloride was recognized, resulting from the decrease in salty taste sensitivity [16,17].

Proven considerable differences between the experimental and control group in the interpretation of salt taste show that elderly patients may unwittingly use more salt, which can further result in adverse health consequences in particular, hypertension and development of cardiovascular diseases [18]. In addition, the available evidence supports the association of high salt intake with the pathophysiology of many other diseases such as osteoporosis, bronchial asthma, kidney stones, and cancers. A diet high in salt may also be a potential cause of obesity, as a result of increased thirst that induces consumption of sweetened beverages [19].

In our study, the identification of sweet taste was 63%, but this was not the worst identified sensory stimulus. A study conducted on the British population showed slightly different results. The greatest changes in taste were related to the decrease in the sweetness sensitivity. Older people were significantly less sensitive to sweet taste compared to younger subjects [15,20]. Conducted in the second stage of the study triangular test for the sweet taste showed significant difficulties in identifying the intensity of sweetness, especially in the elderly. The threshold for saccharose recognition increases 1.5 times with age [21]. Disorders of sweet taste perception may significantly affect the diet of the elderly and entail health consequences related to excess sugar intake. Sweetness sensitivity was also investigated using other sweeteners. A four-fold higher thresholds for saccharine and aspartame was noted among the elderly [14,22].

## Conclusions

1. Disorders in taste perception are a common phenomenon among the elderly, significantly deteriorating their quality of life.
2. A decrease in taste sensitivity was observed, in particular for bitter and salty taste, and to a lesser extent of sweet and sour.

3. Elderly men were characterized by a better ability to sense salty and sweet tastes, while elderly women were more sensitive to bitter taste.
4. The triangle test results for sweet taste showed significant difficulties in identifying the sweet intensity among the elderly, which may cause health implications resulting from excessive sugar consumption.
5. Taste dysfunction in the elderly can be an important factor in the development of eating disorders and consequently lead to a deterioration of health.
- Conflict of interest  
None

## References

1. Wolański N. Rozwój biologiczny człowieka. PWN, 2012 Warszawa. ISBN: 978-83-01-17258-9.
2. Baryłko-Pikielna N, Matuszewska I. Sensoryczne badania żywności. Wydawnictwo Naukowe PTTŻ, 2014 Kraków. ISBN: 978-83-935421-3-0.
3. Baryłko-Pikielna N, Kostyra E. Sensory interaction of umami substances with model food matrices and its hedonic effect. *Food Qual Prefer.* 2007;18(5):751-8.
4. Cooper R, Bilash I, Zubek J. The effect of age on taste sensitivity. *J Gerontol.* 1959;14:56-8.
5. Michikawa T, Nishiwaki Y, Takebayashi T. Are you conscious of any age-related taste impairment? Prevalence of and factors associated with taste impairment in Japan. *J Am Geriatr Soc.* 2011;59(5):951-3.
6. Kamath S. Taste acuity and aging. *Am J Clin Nutr.* 1982;36:766-75.
7. Taniewski M. Badanie smaku. Wyższa Szkoła Turystyki i Hotelarstwa, 2008 Gdańsk. ISBN: 978-83-89081-13-1.
8. Gudej S, Błaszczuk K, Gromadzka-Ostrowska J. Age-related changes in smell and taste perception. *Geriatrics.* 2014;8:109-16.
9. Gawęcki J, Baryłko-Pikielna N. Zmysły a jakość żywności i żywienia. Wydawnictwo Uniwersytetu Przyrodniczego w Poznaniu, 2015. ISBN: 978-83-7160-773-8.
10. Jaroch A, Głowczewska-Siedlecka E, Jaroch K, Podhorecka M. Usual food intake described by Food Intake Variety Questionnaire (FIVEQ) of elderly patients with frailty syndrome – preliminary results. *Gerontol Pol.* 2017;25:163-7.
11. Fukunaga A, Uematsu H, Sugimoto K. Influences of aging on taste perception and oral somatic sensation. *J Gerontol.* 2005;60A(1):109-13.
12. Mojet J, Christ-Hazelhof E, Heidema J. Taste perception with age: generic or specific losses in threshold sensitivity to the five basic tastes? *Chem Sens.* 2001;26:845-60.
13. Schiffman S, Gatlin L, Frey A, et al. Taste perception of bitter compounds in young and elderly person: relation to lipophilicity of bitter compounds. *Neurobiol Aging.* 1994;15:743-50.
14. Mojet J, Christ-Hazelhof E, Heidema J. Taste perception with age: pleasantness and its relationship with threshold sensitivity and supra-threshold intensity of five taste qualities. *Food Qual Pref.* 2005;16:413-23.
15. Wardwell L, Chapman-Novakofski K, Brewer M. Effects of age, gender, and chronic obstructive pulmonary disease on taste acuity. *Int J Food Sci Nutr.* 2009;19:1-14.
16. Klimacka-Nawrot E, Suchocka W, Błońska-Fajfrowska B. Wrażliwość smakowa na chlorek sodu i sacharozę u kobiet i mężczyzn w różnym wieku. *Wiad. Lek.* 2006;59: 778-83.
17. Adamska E, Ostrowska L, Adamska E, et al. Różnice w nawykach i preferencjach żywieniowych osób dorosłych w zależności od wieku. *Rocz Panstw Zakł Hig.* 2012;63(1):73-81. ISSN 0035-7715.
18. World Health Organization. Sodium intake for adults and children. Guideline. 2012. ISBN: 978-92-4-150483-6.
19. Campbell NRC, Johnson JA, Campbell TS. Sodium Consumption: An Individual's Choice? *Int J Hypertens.* 2012. doi:10.1155/2012/860954.
20. Kennedy O, Law C, Methven L, et al. Investigating age-related changes in taste and affects on sensory perceptions of oral nutritional supplements. *Age Ageing.* 2010;39:733-8.
21. Kaneda H, Maeshima K, Goto N, et al. Decline in taste and odor discrimination abilities with age, and relationship between gustation and olfaction. *Chem Senses.* 2000;25:331-7.
22. Easterby-Smith V, Besford J, Heath M. The effect of age on the recognition threshold of three sweeteners: sucrose, saccharin and aspartame. *Gerontology.* 1994;11:39-45.