

## The Human Senses and Elderly

**Glenda Peña-Portillo\*, Ivania Rodríguez-Álvarez, Cira Duarte-García and Olga Zerquera-González**

*Food Evaluation Department, Food Industry Research Institute, Carretera a Guatao km 3 ½, Havana POB 17100, Cuba*

**\*Corresponding Author:** Glenda Peña-Portillo, Food Evaluation Department, Food Industry Research Institute, Carretera a Guatao km 3 ½, Havana POB 17100, Cuba.

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### Abstract

The loss of human senses is one of the many consequences of aging. This new way of coping with life sometimes makes the elderly vulnerable to disease, especially when it comes to the gastrointestinal system.

The onset of anorexia, malabsorption, hypertension or diabetes are closely related to poor nutrition that can lead to the loss of the sense of taste or smell; an endless cycle between age, sensory losses and poor nutrition.

In Cuba, the population over 65 years of age has been increasing over time, being at this moment one of the most aged countries in Latin America and the Caribbean. Studies on nutrition in the elderly, as well as the creation of new products for this age group have been increasing. Therefore, it is necessary to understand the whole process of sensory losses and their influence on nutrition.

**Keywords:** Human senses; sensory; aging; feeding

### Introduction

Nutrition-related problems, as with those derived from geriatric pathology at any other level, have received very little attention. This lack of interest also extends to many of the medical professionals or cultivators of other disciplines of the so-called health sciences, including many of those who, due to the type of specialty they cultivate, should be especially interested in these topics. However, knowing the nutritional status of the elderly, knowing how it can be assessed, identifying the macro and micronutrient needs that they should receive, establishing preventive or corrective measures for common clinical problems such as malnutrition or those derived from acute or chronic situations in which the need for a correct nutritional status is clearly established, they must be priority objectives of any health program and must represent an elementary training aspiration for all health professionals whose daily practice involves elderly people [1].

The nutritional status of the elderly is the result of a series of factors that condition it; among them, stand out the nutritional level maintained over the years, the physiological aging process, the metabolic and dietary alterations, chronic and acute morbidity states, the taking of drugs, the deterioration of functional capacity and psychosocial situations and economical that maintain [2].

Aging is not a disease, but one more stage in the life of the human being, which from a biological perspective is usually accompanied by the reduction and consequently disappearance of some organic functions, as well as its vitality, which makes it vulnerable to diseases various. It should be noted that aging is a complex and dynamic process with inseparable and closely related physiological, psychological and social components. These changes are reflected in the lifestyle and in its interaction with the environment, and have an irreversible and constant impact on the social and economic system of society [3, 4]. Due to these factors, the elderly are a group at risk of malnutrition. Malnutrition favors the appearance of diseases that in turn will have a negative impact on the nutritional status of the elderly, thus establishing a vicious cycle of malnutrition-disease [5].

In the normal aging process, the changes associated with the involution of the sensory systems are notable; mentioning that visual deficit is the most common condition, where the main risk factor is age, followed by complications from chronic-degenerative diseases, the decrease or loss of hearing, it is estimated that it has a prevalence of 90% in people over 80 years or more, the olfactory deficit is directly related to aging, like the taste, which creates a relational triangle between them, having a prevalence of 75% of older adults [6].

The increase in the population of older adults has sparked the interest of researchers in identifying the factors that can influence healthy aging. According to data from the World Health Organization, in the world an unbalanced diet causes 36 million deaths annually and in America more than 4,500,000, which makes it the most serious health problem that exists [7].

The objective of this work is to carry out a review on the changes in sensory perception with aging and the organoleptic characteristics required in foods specially designed for the elderly.

### Cuba and Population Aging

Cuba is among the aged countries in Latin America and the Caribbean, but in two or three decades it will be the most aged [8]. Some of the challenges that the health sector must face as a priority are: the low fertility of the population, aging and the consequent loss of the replacement rate, with the increase in chronic non-communicable diseases (NCDs) [9]. The consequences of aging are directly linked to changes in the social structure and, specifically, to aspects related to the population's health situation, labor resources, social security, family composition, and other basic factors of social dynamics and economic of the country [10].

The phenomenon of the aging of the Cuban population has occurred gradually and fertility, mortality and migrations, variables that in combined action over time determine the growth and age structure of the population, have decisively influenced the time to carry out economic and social health planning in relation to this age group in the country [8, 11]. At the beginning of the 21st century, almost 14.1% of the Cuban population was sixty years old or older, and by 2025 one in four Cubans will be over 60 years old.

In the study carried out by Collazo et al. in 2010 it is stated that many diseases and conditions that appear in old age in Cuba are mostly due to unhealthy lifestyles, risk factors, hereditary problems, among others. Some of these diseases can become triggers of a series of factors that cause an early loss or an imbalance in different aspects of sensory perception.

The way in which one ages and lives this process (health and functional capacity) depend not only on the genetic makeup, but also -and importantly- on what has been done during life; of the events that have had to live throughout it; and how and where they have lived [10]. Sensory alterations in the elderly are especially important not only because of their high prevalence, but, above all, because of the repercussions that in the functional, psychological and social areas of the elderly [6].

The prevalence of arterial hypertension, diabetes mellitus and cerebrovascular disease for the Cuban elderly is 523.7, 172.5 and 24.3 respectively, for a rate per 1000 inhabitants. In the case of hypertension and diabetes, the incidence in the female population is higher; but this is not the case in cerebrovascular diseases [12].

When carrying out Research, development and innovation (R + D + i) projects in the food sector, specifically focused on the elderly, it is necessary take into account not only the foods that from the nutritional point of view compensate for the deficiencies that this age group may present; but from the sensory aspect, these foods should be as consistent as possible with this population sector.

### Nutritional requirements in the elderly. Brief approach

The aging of the population is associated with a higher prevalence of nutritional problems. Older adults are at greater risk of suffering from malnutrition due to different factors such as decreased food intake, anorexia associated with psychosocial factors, chewing and swallowing problems, physiological changes in gastrointestinal function, among others [13].

During the aging process, changes occur in the gastrointestinal tract that affects the ability to digest and absorb food. For example,

hypochlorhydria or drug interactions, widely used at this age, can cause malabsorption problems. Changes in kidney function can affect the balance between intake and excretion of nitrogen, water, and electrolytes. In this period there is a progressive replacement of lean mass by fat and connective tissue. There is a greater distribution of fat in the trunk and around the viscera. Loss of endogenous opioids and the exaggerated effects of cholecystokinin, both related to a normal appetite response, can contribute to the anorexia often seen in older people [12].

With age there are a series of changes that will modify the nutritional energy requirements, mainly due to the reduction of physical activity, voluntary or associated with disabilities, and changes in body composition; specifically, the decrease in lean mass leads to a decrease in the basal metabolic rate from 1% to 2% per decade after the age of 20.

Hypocaloric diets or periods of fasting in older people can favor the appearance of important metabolic disorders such as lipolysis, the production of ketone bodies, protein catabolism and the loss of sodium, potassium and fluids. Relative fasting studies have shown that people over 60 years of age lose weight more quickly than younger people, and when the restriction ceases, it is very difficult for them to increase their food intake to gain one kilogram of weight and regain the lost weight.

On the other hand, among the components of foods already known and studied as determinants of sensory properties, especially color, it is necessary to point out the carotenoids and polyphenols, which are part of the composition of many foods, and due to their nature Antioxidants are also incorporated into the so-called functional foods, that is, those foods that in addition to nourishing (meeting needs and avoiding deficiencies) have protective or even preventive effects against some diseases [1].

For the particular case of Cuba, in the Dietary Guidelines for the Cuban Population over two years of age, published in 2009, it is established that for the adult population over 60 years of age, the recommended intake for men is 2013 kcal / day and for women 1875 kcal / day, for a sedentary lifestyle, while for an active lifestyle the requirements are 2402 kcal / day and 2238 kcal / day for men and women respectively. According to the WHO, a 65-year-old man of average constitution will need around 1900-2100 kcal / day while a 65-year-old woman of average constitution will oscillate between 1500-1700 kcal / day. It is important to bear in mind that contributions of less than 1500 calories / day pose a risk of low vitamin and mineral intake, which prevents meeting the daily nutritional requirements [14, 15].

Fruits rich in fiber, whole grain products, vegetables, grains, cereals and tubers, are foods rich in carbohydrates, the main source of energy for the body because they break down quickly.

Vitamins A, D and group B are usually the most affected along with calcium, magnesium, iron and zinc, in the elderly. These generally subclinical states of poor nutritional status have a substantial influence on body composition, functional integrity of the digestive system and immunocompetence, the first step to increase susceptibility to infectious and oncological processes, cognitive alterations and acceleration of aging processes [16].

The influence of zinc on immune function has drawn attention in recent years. During malnutrition, a thymic involution occurs that is proportional to its severity and that causes an immunological imbalance that is clinically manifested by the appearance, persistence or recurrence of infectious pictures. In the elderly, zinc concentrations have been studied extensively, since its deficiency is more frequent in the extreme ages of life [17].

In addition, it is believed that zinc behaves as an important factor in the cell regeneration of the taste buds, since it influences the activity of intravenous carbonic anhydrase and therefore the level of gustine, an important metalloprotein that has been described as a stimulating growth factor for taste cells. However, the mechanism by which zinc influences dysgeusia is not well known. Also, a low level of copper is related to glucose intolerance and even anemia and osteoporosis.

As for copper, it is an essential micronutrient for the development, growth and maintenance of the immune system, being necessary for the differentiation, maturation and activation of the different types of immunocompetent cells, as well as for the secretion of cyto-

kines, with autocrine and paracrine properties. and endocrine, thus exerting a correct defense of the host [18].

Likewise, iron in the body is located as part of hemoglobin. Iron requirements decrease in the elderly, reaching around 8 mg / day, because their deposits increase, in the case of adult women, it is also accentuated due to the non-existence of menstrual loss. Despite this, an iron deficiency can occur in the elderly due to an insufficient contribution of it in the diet, or due to blood loss due to intestinal bleeding, hiatal hernia, stress, in gastrectomized people, or with malabsorption pictures and by taking medications such as antacids that inhibit their absorption.

Varela and Ortega, in a study carried out in 1987 state that the main causes of deficiency in water-soluble vitamins in the elderly are changes in diet, monotony and suppression of some food from the diet; also some pathologies and chronic drug use.

Many are the macro and micro nutrients necessary at this stage, since they influence various processes that considerably improve the quality of life. However, it is no less true that certain factors cause that not only malabsorption, but also the lack of adequate nutrition, threatens correct nutrition in the elderly.

A study carried out by Montejano-Lozoya et al. (2014) demonstrated that the relationship between the risk of malnutrition and the variables related to food and digestion are: eating a few times a day (three times or less) when the total daily intake is divided, having a poor appetite, suffering from impaired taste, xerostomia, maladjustment of removable dentures, difficulty chewing, swallowing and vomiting regularly. The authors point out that it has been observed that maintaining diets prescribed and controlled by professionals in general, and in particular eating a diet low in sodium and having an excessive appetite, act as a protective effect of nutritional risk.

### Sensory Loss in the Elderly

The alteration in sensory perception is a condition that is related to the response threshold of sensory neurons, which is understood as the minimum necessary stimulus of a chemical or physical nature that a receptor terminal needs (taste bud, olfactory, retinal cells, Meissner corpuscles) to emit an electrical response (receptor potential) which - when received by the sensory cerebral cortex - is interpreted (perception) as taste, smell, vision, hearing or touch, respectively. In the elderly it is very likely that the deficit in taste perception (chemosensory alteration) is related to a real reduction in taste threshold [3].

From the age of 60, even healthy individuals show a small decrease in the intensity with which flavors are perceived and, more markedly, smells. The biggest problem with sensory impairment in the elderly is its progressiveness. The decline in the sensation of taste is a prominent factor in decreased appetite in the elderly, weight loss and malnutrition, which also increases the probability of contracting diseases.

During old age, sensitivity to taste and aroma play an important role in energy deregulation; in particular, most studies suggest that the detection and recognition of the threshold of salt and other specific flavors are affected with age, in part by the use of drugs that impact taste but also by the functional loss of smell and taste [19]. Serrano et al. in 2010 they stated that although in old age both the sensory quality and the number of taste buds decrease, the olfactory sensation continues to be extensive, a fact that allows a pleasant life adjusted to the surrounding world; however, Rico et al. a year later they stated, in another study, that hyposmia or partial decrease in the ability to perceive odors, hypogeusia and ageusia are the most frequent alterations. This last approach could be the most successful, as various geriatric studies confirm this. As a consequence, the loss of smell can cause all foods to taste the same, which deprives the elderly of the satisfaction of eating, and therefore is another cause of malnutrition at that age.

The truth is that gastronomic taste is not neutral, whether it refers to the color of the food, or its flavor, or its texture: the sensory data are already translated symbolically, according to the way in which reality is offered and according to what it is welcome in a life project.

Although taste receptors occasionally become sensitive to required nutrients, the mechanism of taste preference is thought to be

central. Previous experience of pleasant or unpleasant flavors plays a very important role in determining taste preferences [20].

The most affected flavors, after the onset of sensory losses, in these cases are sweet and salty, while bitter and acid tend to be more resistant. However, there are other factors that can influence the perception of taste such as lower saliva production, digestion and/or dental problems that tend to be frequent in advanced ages.

With age there is a progressive loss of taste buds that affects, above all, the anterior part of the tongue in which those that preferentially detect sweet and salty flavors are located. Hypogeusia seems to be due to a deficiency in vitamins A, B6 and folic acid but, above all, it is associated with that of zinc; Low serum levels common to aging are related to taste disorders and the consequent decrease in appetite. This taste insensitivity can be improved by increasing the intake of zinc, copper and chromium [21, 22]. Each remaining taste bud also begins to shrink. Sensitivity to the 5 taste sensations often decreases after the age of 60. Also the mouth produces less saliva as you age. This can cause a dry mouth that can affect your sense of taste.

Various studies on preferences indicate that older adults prefer higher concentrations of stimuli for solutions of sucrose, sodium chloride, and citric acid than younger subjects. However, this preference could not be associated with a higher consumption of foods containing substances that can stimulate these flavors [23, 24]. According to a study carried out by Velasco-Rodríguez et al., it was evidenced that in the elderly, the taste threshold for the basic sweet, salty, bitter and acid flavors presents a significant reduction with respect to the values reported as normal in the medical literature. They were also able to verify that there are statistically significant differences that show that there really is a physiological reduction of this sensory parameter, although this significance was not evidenced in the acid taste.

In the case of smell, both the sensory cells of the olfactory mucosa and the cognitive processing areas located in the brain begin to decline with age, these being the main causes that odors are no longer perceived with the same intensity as before. Other causes could be liver disease, cancer, or the cognitive decline typical of Alzheimer's disease.

Olfactory function declines through the aging process and not only is olfactory acuity lost, but also the ability to discriminate between different smells. It has been reported that more than 75% of adults over 80 years of age present evidence of alterations in the sense of smell [25].

There is a progressive decrease in olfactory receptors and olfactory sensitivity is reduced (hyposmia) and/or distorted (dysosmia), especially after 70 years. In a few cases, smell is completely lost (anosmia). The increase in the viscosity of the mucus also contributes to the alteration of the smell and also decreases the sensitivity to concentrated odors [16].

Some studies suggest that olfactory ability is maintained with aging and that, in fact, the loss of sensation in older adults is related to diseases, smoking, epilepsy, nasal congestion, upper respiratory tract infection and other environmental exposures throughout of the life [16, 25].

These age-related deficits in taste and smell can decrease food consumption and probably contribute negatively to changes in eating behavior; although few studies have explored the relationship between sensory impairment, hedonic response and alterations in food intake in the elderly [3, 23].

Alterations in taste and smell limit the ability to enjoy food but also carry the risk of not being able to detect food that is in bad condition. On the other hand, in situations of lack of appetite, the loss of these sensations can reinforce the lack of appetite and make it more difficult to accept the dishes. Chewing food well and moving food through the mouth reinforces the intensity of the flavors. It is very important to take care of the presentation, the texture and the seasoning of the dishes. In situations of low caloric intake, by reducing the number of meals and the amount of food ingested in each intake, it is very difficult to provide the amount of nutrients necessary to meet nutritional needs.

But not only physical factors, negatively influence sensory perception in older adults; some consumed medications alter taste, rejecting food: captopril, enalapril, amiloride, hydrochlorothiazide, spironolactone, nifedipine, diltiazem, propranolol, ibuprofen, penicillin, lincomycin, metronidazole, clarithromycin, ethambutol, carbamazepine, sulmavorazole, carbamazepine, lemmavorazole, carbamazepine, zopiclone, 5-fluorouracil [26].

On the other hand, the atrophy of the taste buds (a process that begins around the age of 50) produces changes in sensitivity to flavors, which leads to the consumption of strongly seasoned or sugary foods [27, 28].

In a review carried out by López-Ortiz in the 2015, it states that comparisons of functional magnetic resonance images have been made during the perception of sweet taste, of young people between 19 and 26 years of age and adults between 45 and 54 years of age, which revealed a greater activation of the hedonic response in young adults, but not with the bitter taste. These results are thought to reflect early age-related differences in central taste processing, which may occur before the deficits in taste function seen in old age. These results correspond to some degree with other studies carried out.

The elderly need an adequate supply of fat as a source of energy, a vehicle for fat-soluble vitamins and also to improve the palatability of the diet [5]. Evidence suggests that taste, texture and smell are involved to varying degrees in the detection of fatty foods from free fatty acids in the oral cavity and there are still key elements that must be addressed to consider fat as a basic taste [29].

Chewing difficulties can cause a rejection of raw fruits and vegetables with a consequent decrease in fiber intake. The lack of fiber can aggravate some of the common problems in the elderly such as constipation, the use of laxatives and diverticulitis [5].

Other sensory losses related to the elderly include loss of sight and hearing. The prevalence of blindness is highly dependent on where it is measured. People between the ages of 65 and 75 have a 4-5% rate of visual problems. Above 75 years the figures reach approximately 20%. From the age of 65 there is a constant decrease in visual acuity, contrast sensitivity, tolerance to glare and visual fields. Depth perception worsens after 75 years. Another important issue is vision impairment due to uncorrected or poorly corrected refractive errors [6, 30].

As for hearing loss, it may be due to genetic causes, complications in childbirth, some infectious diseases, chronic ear infections, the use of certain drugs, exposure to excessive noise, and aging [31]. Hearing loss is extremely prevalent; it affects one third of those in their sixties, two thirds of those in their seventies and three quarters of those over 80 years of age. Impaired hearing for high frequencies (consonants in speech) is typical, while hearing for low frequencies (vowels) is preserved. Risk factors associated with hearing loss are: high blood pressure, diabetes mellitus, cognitive impairment, exposure to noise, use or exposure to ototoxic agents, ear infections [30].

Diseases such as hypertension or diabetes can be largely conditioned not only by age, but also by eating habits, which are known to change with age. This could generate a vicious circle where sensory losses cause significant changes in the diet of the elderly, while these changes in diet are generating physical changes that can be translated into sensory losses.

## Feeding in the Elderly

The results of the National Survey of Population Aging indicate the level of consumption of basic foods such as dairy products, eggs and beans, meats and fruits or vegetables. The foods of almost general consumption by older adults are eggs, and grains or legumes, while they opt less for dairy products and fruits or vegetables. No difference is appreciated by sex or age in these findings, except in the case of dairy products that are part of the diet of a higher percentage of adults aged 75 and over, than of the younger group [32].

Inadequate intake should be considered as the first stage of nutritional depletion, which will inevitably follow, if not corrected, by biochemical alterations and, finally, by clinical manifestations. To make a dietary assessment or nutritional interview, it must be borne in mind that it is necessary to know the composition of food in general. For this, it is necessary to have composition tables and a group-

ing scheme of the different foods by their characteristics and take into account the recommendations for energy and nutrient intake indicated by the expert bodies and committees [33].

One of the biggest problems that arise when preparing food for this age group is related to the texture of the food.

The so-called shredded diets allow obtaining different levels of consistency depending on the possibilities of the elderly. In this diet, foods with double texture such as soup with pasta or cereals with milk are allowed, as long as they do not make chewing or swallowing difficult. At this point, it is important to take into account the organoleptic characteristics of the preparation (color, aroma, flavor, temperature) that somehow condition the act of eating.

Foods with a mild taste, and served at room temperature, are recommended for swallowing disorder. Likewise, foods that do not have double texture are recommended such as broth with noodles, jelly with fruits, minced meat with broth, canned fruit with juice and cereals with milk. It is preferable to select foods that form a bolus inside the mouth or that do not fall apart. For example the banana, mashed potatoes and mac with cheese. If excess mucus formation is a problem, sweet foods, dairy products, and juices should be avoided as they increase or thicken saliva [34].

As for older adults with chewing problems, either due to being edentulous or due to inadequate prostheses, a soft mechanical or easy chewing diet is recommended. Foods such as cooked or pureed vegetables, dairy (avoiding hard cheeses), juices and juices, very ripe fruits, eggs, minced or stewed meats, fish, as well as whole or pureed legumes (depending on individual tolerance), should be the recommended diet for subjects in this age group.

The absence of teeth, especially in the elderly, requires limiting oral grinding, which makes digestion more difficult and annoying. All this results in the fact that the elderly tend to choose some foods and reject others so that in this selection process they may lose nutritional capacity.

According to Mathey et al. (2001), the use of flavor enhancers could be suggested to compensate for the decrease in chemosensory function, which contributes to appetite control problems in the elderly, or the so-called anorexia of aging. Improving taste could restore the hedonic functions of food and therefore promote a partial restoration of the original attitude and behavioral response of this population towards food intake.

The decrease in taste and olfactory functions in the elderly often leads to an increase in the consumption of very salty or sweet foods to enhance the taste sensation, a fact that can lead to a worsening of glycemic control or high blood pressure [35].

Including foods with a higher level of acidity in the diet could help, since acidic flavors, such as lemon, trigger the swallowing mechanism, which could help with underlying pathologies in the elderly, such as xerostomia, or dry mouth, due to a decrease in salivary secretion.

That is why in the case of dysgeusia, the variety of foods must be increased to identify and discard those that produce altered flavors and decrease the perception of the aroma and flavor of the food. It should be taken into account that the metallic taste and the lowering of the threshold for bitter tastes are common in dysgeusia, and that fat, heat, closed containers and certain culinary preparations increase the taste and odor of food.

The current diet is rich in simple carbohydrates (sugars) with empty calories, saturated animal fats and animal proteins, low in fiber and high in salt and excessively seasoned. This diet favors cardiovascular risk, diabetes, overweight/obesity and certain types of cancers are known as "diseases of civilization". A healthy, varied and balanced diet is one that provides the necessary energy to maintain our daily activity and a stable weight, that is, the one that maintains a balance between energy intake and organic consumption or expenditure [26].

On the other hand, alterations in glucose homeostasis in the elderly may contribute to altering hunger and satiety, since it has been

postulated that glucose in the blood is a trigger for hunger signals in humans. Foods with a high glycemic index are used as reference, such as white bread, cereals and other refined carbohydrates (glycemic index of 100-120) with a value fixed at 100 and that induce relative hypoglycemia 90 to 120 minutes after consumption of these. Foods that condition a faster return to hunger and an increase in energy consumption later (overeating) [19].

## Conclusions

Due to decreased taste and smell in the elderly, interest and pleasure in eating may be reduced. The presentation of food in this regard is of utmost importance; the use of attractive colors that evoke a feeling of well-being and desire are valid starting points for the production of products for the elderly.

Due to the dissimilar physical affectations that occur during aging, in terms of texture it can be concluded that foods should be made that in general can meet the needs of the majority of this population sector. Liquid foods are usually suitable for those elderly with swallowing or chewing problems; while solid foods with a soft constitution either pureed or gelled foods may also be recommended.

Although the sensory losses show gradually, it is necessary to search for alternatives that efficiently combine the texture and flavor of the food, while from the nutritional point of view the necessary caloric requirements are met; even work on the production of functional foods that promote the health, physical capacity and mental state of the individual.

## Conflict of Interest and Acknowledgements

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