The ageing palate

Assistant Professor Elisabet Rothenberg and Professor Karin Wendin of Kristianstad University in Sweden investigate the changing demands of food and nutrition with ageing.

Designing food for the elderly is an important part of their quality of life and may be considered as prevention for those with good health and as a medical treatment for those who are old and frail and at high risk of malnutrition. Worldwide the population is growing older making specially designed foods providing appropriate nutrition, texture and sensory properties a key area for development in the food industry.

Life expectancy has risen rapidly in the last century worldwide [1]. In 2012, the proportion of the population aged 65 years and above in the European Union was about 18% [1]. It is expected to increase to one third of the total population by 2060 and the proportion of people aged 80 years and over is projected to almost triple between 2011 and 2060.

Physiological changes with age
The majority of older adults are reported to be in good health, however, ageing is an irreversible and progressive process affecting social, mental and physiological functions; it is associated with reduced margins and impairments in a number of vital physiological systems. This progressive change is called frailty, leading to increase in morbidity and mortality rates [2]. One expression of frailty is sarcopenia defined as ‘a syndrome characterised by progressive and generalised loss of skeletal muscle mass and strength with a risk of adverse outcomes, such as physical disability, poor quality of life and death’. An interrelated term is malnutrition meaning ‘a state resulting from lack of uptake or intake of nutrition leading to altered body composition [decreased fat free mass] and impaired clinical outcome from disease’. When caused by disease it is labelled disease-related malnutrition (DRM) – a growing problem with increasing age. To keep older adults above the threshold of disability is a momentous challenge for society (Figure 1) [2].

Dysphagia
The risk of developing dysphagia (swallowing difficulties) increases with advancing age because under ‘normal’ conditions many old individuals are already using their swallowing function to the maximum capacity. Age-related changes include all steps in the swallowing process. As a result, risk of airway penetration increases and sensory capability and esophageal motility decrease. Skeletal muscle mass is of great importance also for swallowing and sarcopenic

Figure 1 Maintaining functional capacity over the life course

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* Sources in the environment can lower the disability threshold, thus decreasing the number of disabled people in a given community.
Dysphagia occurs when muscles involved in the swallowing process are affected by sarcopenia. The prevalence of dysphagia differs between studies but more than 50% of patients with acute stroke have been shown to be affected. The symptoms may regress but for some the condition will remain permanent and texture modified food or enteral nutrition are necessary for adequate nutrition and quality of life. Nearly every patient with Parkinson’s disease and a third of patients with multiple sclerosis show impaired eating and swallowing ability. The prevalence in hospitals and nursing homes has been estimated to be about 50%. The incidence increases markedly in very old people, i.e. over 85 years, depending on the prevalence of disease [4]. In patients suffering from dementia over 70% are affected by oral dysfunction. Dental problems that hinder the ability to chew are also common.

Saliva is needed to keep food particles moving and for lubrication, bolus formation and swallowing. During chewing, salivary enzymes interact with some specific food components (e.g. starch, lipids) leading to oral digestion of food. Saliva is also important for the experience of taste and smell. A saliva layer is of great importance to the body’s natural defenses against bacterial, viral and fungal infections. Many studies have confirmed that increasing age causes a decrease in salivation increasing risk of tooth decay and difficulties with eating and swallowing.

Changing nutritional needs
A healthy diet is crucial for maintenance of health but nutritional needs change with age. The need for energy normally decreases in relation to a decrease in physical activity. However, the need for micronutrients does not necessarily decrease. This implies that for elderly people with reduced appetite there is a need to increase the nutrient density of the food they consume. Adequate energy intake to maintain body weight, protein and vitamin D are of especial importance to maintain muscle mass during ageing. Higher amounts of protein per kilo body weight are needed to provide muscle tissue with enough protein to maintain adequate muscle mass synthesis. Leucine, an essential, branched amino acid, has been shown to be particularly efficient at stimulating muscle protein synthesis. About 25-30 g of protein per meal is suggested for an optimal effect on muscle mass. Vitamin D in its active form is a hormone with pleiotropic functions and vital roles in several physiological systems including the muscles. A great proportion of older adults show low levels of this vitamin. A level of 20 μg/day vitamin D has been recommended for those over 75 years [5].

Sensory perception of food
Sensory dysfunction is common among the elderly, affecting perception and enjoyment of food. The sensory loss increases with age, food recognition becomes harder and often results in negative food intake and loss of appetite. For example, it has been shown that odour sensitivity decreased more than discrimination and identification of odours [4, 6].

Avoiding malnutrition
Decreased functionality of senses and eating and swallowing problems together with impaired appetite are common causes of malnutrition and dehydration. In order to maintain nutritional status, it is recommended that food with increased energy and nutrient density should be served in small portions with a frequency of 5–6 times per day.

The choice of foods for meal preparation needs consideration. For example, elderly people often find foods rich in protein, such as beef and other whole meat dishes, difficult to eat, while dairy products are often well tolerated due to the smooth and soft texture. Familiar, good-tasting, appetising foods with nutritional compositions that meet the dietary requirements are essential for well-being and for the capability to respond to medical treatments.

Texture modification
The effects of dysphagia may range from mouth dryness to not being able to swallow. Difficulties in ingesting food and liquids are common. In order to facilitate oral intake, texture modification has been
Figure 3. The Five Aspects Meal Model

FAMM includes the following aspects:

- **The room setting**: the physical environment is important for meal consumption.
- **The meeting**: staff eating together with the elderly creates conditions for a pleasant and positive dining experience.
- **The product**: the food must be adapted to meet the needs and preferences.
- **The atmosphere**: older people are sensible to stress. Therefore, meals should be served in a peaceful and quiet atmosphere to create optimal conditions for eating.
- **The management control system**: the management control system comprises administration, economic and legal aspects and leadership. Texture modified foods often consist of mixed and minced ingredients and therefore are extremely at risk of bacterial contamination.

shown to be a successful strategy [4, 7]. Studies have shown increased body weight due to increased oral intake of texture modified food. The rheological properties of the food (e.g. viscosity) are crucial for swallowing and transportation of the bolus. Measurements of the rheology of different foods and liquids may be difficult due to variations in ingredient composition, serving temperature and time effects (e.g. storage). However, precise definitions and objective rheological measurements are necessary for successful treatment with a texture-modified diet [8]. A food texture-modification guide was developed during a Swedish research project [9] with the purpose of defining distinctive food texture terms. The following categories are proposed: ‘Regular or cut’, ‘Coarse pates’, ‘Timbales’, ‘Jellied products’, ‘Liquids’ and ‘Thickened liquids’. These terms are recommended by the Swedish Government for use in the management of dysphagia. To further elucidate the physical and sensory meaning of these terms, objective rheological as well as subjective analytical sensory measurements have been conducted [9].

**Sensory aspects of food manufacturing**

The rheological properties of a food have a great impact on the swallowing time. Food taste and flavours are perceived together with texture-related sensations during chewing and swallowing. Suffering from dysphagia turns eating into a difficult process and many dysphagic people lose their enjoyment of eating. It is a challenge to design food with modified texture, attractive sensory properties and recommended nutritional content as well as making it safe for consumption. A design strategy called ‘creative design’ can be used to reach this goal [10].

Creative design is an extension of experimental design and the idea is to use both creativity and experience while systematically exploring the appeal of possible products to consumers. Both objective analytical sensory science and consumer tests are recommended during the development process [10].

In order to design and produce texture modified foods, different factors may be varied: the fat content, the size of fat droplets, addition of thickeners and different emulsifying agents. As an example of manufacturing design, it was shown that increased oil content gave coarser and juicier meat products and that a high proportion of added egg yolk gave soft, coarse and fatty carrot products. Compared to puréed products, a milling size of 2 mm gave a more juicy and soft meat product. A coarser texture of the meat products was obtained by the use of cold-swelling starch instead of warm-swelling. Increasing the starch content also increased the number of detectable particles in the carrot-products [11].

**Meal situation**

The experience of a meal is an important part of the quality of life, but the scientific evidence regarding optimal conditions for an appetite stimulating meal is quite limited. The Five Aspects Meal Model (FAMM) was originally developed for planning service delivery to enhance customers’ satisfaction in restaurants [12]. However, the model has been found to be useful in understanding the importance of different aspects involved in a meal in various care settings and for the creation of optimal conditions for consumption by older adults [Figure 3].

**Conclusions**

Elderly individuals suffering from disease or functional and mental impairments are vulnerable to malnutrition and therefore may incur several negative health outcomes. For these individuals food must be regarded as a part of the medical treatment. Proper identification and assessment of nutrition-related problems are needed in order to establish appropriate treatment. When dysphagia is present, texture modified foods become a critical part of treatment. Many factors need to be considered when designing texture modified foods, including energy and nutrient content, palatability, texture, food services and food packaging.

Tailor-made nutritious and palatable texture modified foods can be developed for individual purposes and needs. With higher accessibility, for example in food stores, the texture modified food may reach more people and can be used in the prevention of malnutrition, for convenience and improved quality of life.
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References