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NUTRI-SENEX

Improving the quality of life of elderly people by co-ordinating research into malnutrition of the elderly

Work Package 5 Report:
D17 - Recommendations for future food product developments

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Work Package 5 – Mapping of product development

Executive summary

**Project - Aim & description**
In January 2004, the project Nutri-Senex (Improving the quality of life of elderly people by co-ordinating research into malnutrition of the elderly) was launched. Nutri-Senex is funded by the Sixth Framework of the European Union (EU), a programme which supports research co-operation and integration of research efforts, promotes mobility and co-ordination and invests into mobilising research in support of other EU policies. This project was initiated in response to changing population demographics, which predict a significant increase in the older age group. The project’s primary aim is to improve understanding of how diet can promote healthy aging. The global objectives are to co-ordinate research into the nutrition of older people; to improve their quality of life; to reduce public health costs through the prevention of nutrition related diseases; and to encourage the development of nutritionally balanced food products specially designed for older people. The focus of the project is on the taste and smell losses that occur with ageing, and how these changes decrease the enjoyment of food, and may subsequently reduce food consumption and negatively influence the nutritional status of older people. The project involves 28 participating centres from 9 European countries.

**Work package 5 - Aim & description**
Work package 5 (WP5) is one of seven work packages; each has specific objectives, all of which are necessary as part of the overall objective. There are 11 partners involved in WP5 for the duration of the project (36 months). The work package leader, UCC, will co-ordinate the activities and also play a leading role in the data collection. All activities and initiatives within the food industry aimed at addressing the special needs of vulnerable older people in terms of the production of specially tailored foods will be studied.

The first objective of WP5 was the compilation of a database of food producers and manufacturers with an interest in the area. This database will be a public document and will also assist carers and care home operators to choose better food for those in their care.
Secondly, the ensuing report was prepared, detailing how best to encourage the uptake of foods designed to promote long-life and well-being amongst this vulnerable and rapidly growing sector of society. The review is divided into three separate areas. Firstly, SENDATEK, WU, DIFE & NIZO were responsible for producing a review of all activities and incentives involving improvements in the nutrition of older people. NIZO led this task, under the supervision of UCC. The second review is of all activities and incentives involving improvements in the use of dietary additives and flavour enhancers specifically directed at older people. BIMBO led this task, assisted by WIEN and KI. The third and final area reviewed was packaging and marketing. BIMBO, under the leadership of FINDUS, reviewed all activities and incentives aimed at improving the use of age-friendly packaging for food products. The marketing of these products towards purchasers for care homes, nursing providers, carers, etc. was also considered. UCC was responsible for combining the results from all three reviews into a single document.

Outcomes of report

The main outcomes of the report can be seen as recommendations for future developments in food products beneficial to older people, into three broad categories; Nutrition, Sensory Acceptability and Marketing and Packaging (Design and Labelling). It is important to note at the outset that the older population is a diverse one, including healthy, active younger seniors and frail seniors, with differing physiological requirements, attitudes and lifestyles.

Nutrition

In relation to Nutrition, a healthy balanced diet, adequate fluid intakes and moderate physical activity are key modifiable risk factors that can offset the development of frailty in seniors (≥ 70 years in particular). Unlike their younger counterparts, some seniors start to lose body weight, particularly lean body mass, as they get older. The energy density of the diet is a key factor in maintaining body weight, particularly in seniors whose appetite is decreased. Residential home-based research has shown that serving energy-dense food as opposed to a second evening meal (or supper) is a more effective way to improve energy intake in older people. Furthermore, a more diverse diet predicts better nutritional status in frail older people persons. New dietary guidelines for older people should emphasize the importance of high quality, nutrient-dense foods. Against the context of a global obesity epidemic, challenges for the future include designing appropriate energy and nutrient-dense foodstuffs for older people and marketing them at the target population without labelling them as “elderly food”.

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Sensory Acceptability
From the sensory perspective, recommendations to enhance the flavour of foods for the older people has been widely advocated, as there are many reported benefits. It has been hypothesized that monosodium glutamate (MSG) could be used selectively by the food industry, in order to promote the perception of healthy foodstuffs as flavoursome, thus promoting consumption of a healthier diet. Colour also plays a key role in food choice, as it has been shown to replace sugar and still maintain sweetness perception in flavoured foods. Enhancing sweetness by using sweeteners rather than sugar would aid in weight maintenance in overweight younger seniors. Furthermore, certain textures were found to be more troublesome for older people while others were deemed easier. Research also showed that foods requiring long chewing times created problems.

Marketing
Regarding marketing products for older people, it is important in this context also to realise there is more than one market within the diverse senior sector. Seniors are often all grouped together in marketing studies, which can prove to be a mistake. While some senior people are still very fit, active and healthy, others are physically and or mentally incapacitated. Sensitive market research is recommended, to give older consumers a chance to interact with and comment on packages intended for them. Older people are more reliable when it comes to discovering the truth!

Packaging
In the same context, labelling a product specifically for the “elderly” may be the fastest way to position it for failure. Research indicates that screw closures, glass, tin, plastic and flexible packaging creates the most problems. Older consumers appreciate tear tapes and clear instructions on how to open packaging. Avoid referring to those over 60 as elderly people, instead use words such as, older, mature, boomer or senior. Products marketed towards the elderly may conflict with active, younger seniors’ fears of failing health and being seen by their friends and families as getting old. This is a perception issue. One approach might be to rephrase the labelling from “designed for the elderly” to “designed for adults, not children”.

Also with respect to packaging, legibility is an issue due to failing eyesight; certain colours are easier on the eyes for people who have macular degeneration or glaucoma. Bold labels
with a contrasting colour background are easier to read. Seniors tend to eat smaller portions, so packagers need to factor that into packaging equations.

**Outputs of project**

The main outputs of the project will lead to better co-ordinated European research, less duplication of effort and more rapid commercialisation; increased awareness of the problems faced by older people; improved guidelines and recommendations for healthcare professionals and policymakers; and improved quality of life for older people, through an improvement in the range and quality of food products aimed at this sector of society. The success of this goal will be measured by analysing developments in the WP5 database throughout the project.
Introduction

Europe’s population is ageing at an unprecedented rate according to the United Nations, predictions show that by 2050, 34% of all European adults are expected to be over sixty years of age (United Nations, 2001).

Advances in science and medicine as well as improved living standards have led to a steady increase in life expectancy. Yet ageing is associated with increased susceptibility to degenerative or infectious diseases, which may be exacerbated by a poor nutritional status (1). Ageing is associated with a variety of physiological, behavioural and socio-economic changes. All of these factors could negatively affect nutritional behaviour and dietary intake. Thus, older people are at an increased risk of impaired nutrition and health status. Many epidemiological studies suggest that inadequate nutrition may strongly influence health status in both young and older people (2). A nutritionally adequate diet is considered a critical component of a lifestyle aimed at promoting healthful and active aging (3, 4).

Older persons tend to adapt their diets in response to individual functional difficulties, often leading to monotonous food consumption and, as a consequence, to inadequate nutrient intakes (5). Difficulties in nutrition-related activities (chewing, self-feeding, shopping for basic necessities, carrying a shopping bag, cooking a warm meal, using fingers to grasp or handle) increase the risk of inadequate intake of energy and nutrients (5). More attention to functional problems in older people population and the provision of formal or informal help to those who have difficulty in purchasing, processing and eating food may reduce, at least in part, the percentage of older persons with poor nutrition (5).

Physical conditions common in older persons, such as, disability, medication-induced anorexia, poor dentition, restrictive diets, gastrointestinal diseases, and metabolic disorders (such as diabetes mellitus and renal failure), all affect nutritional intake and metabolic demand (6). Furthermore, cultural and psychosocial issues, such as living alone, bereavement, situational depression, and religious beliefs, may reduce nutrient intake and affect an older person's use of social services, such as Meals on Wheels. Finally, system barriers may exist that reduce dietary intake, particularly in persons who live in long-term care facilities where restrictive meal times may limit the capacity to "graze" and where inadequate staffing may not allow sufficient devotion of personnel time to assist those who cannot feed themselves (6).
Recommendations for future food product developments
To encourage the uptake of foods designed to promote long-life and well-being amongst the older, the food industry must first be convinced of the importance of the senior market. A change in food product development needs to be initiated in response to this rapidly growing sector of the population. In general, seniors are demanding more suitable and acceptable food products, in terms of taste, flavour, health benefits, convenience and packaging.

Nutrition
A better understanding is required of food manufacturers, of the factors affecting food choices made by older people. Besides difficulties with packaging, seniors also experience nutritional and sensory problems. Evidently, food consumption and food choice are paramount in improving the nutrition of older people. An understanding of the mechanisms of food choice and acceptance is a fundamental part of all attempts to improve the competitiveness of the European food and drink sector (7). Food choice, like any complex human behaviour, is influenced by many interrelating factors, including various physiological, social and cultural factors, and these need to be taken into account when considering dietary interventions (8).

It is difficult to determine the nutrient needs of older people, as there is considerable variation among different communities in terms of the rate of age-related decline (9). A decline in energy intake as well as energy expenditure generally accompanies old age. This declining need for energy is primarily due to a reduction in the amount of lean body mass and a more sedentary lifestyle (10). However, a reduced energy intake is inevitably accompanied by a reduced nutrient intake, this is an even greater concern when the reduced intake of particular nutrients for example, folic acid may actually increase risk of cardiovascular disease (11). Nutrient deficiencies are frequent amongst older people, the nutrients, which are of particular concern in older people, are calcium, vitamin D and vitamin B12. There is evidence that the requirement for certain nutrients increase with ageing, for example vitamins B6, B12, K and folate are some of the nutrients that have a protective role to play in the ageing process (11, 12). A recent study revealed that a wide range of vitamins and minerals could be safely added to foods at nutritionally important levels in the European diet (13). This conclusion was based on a theoretical model developed to determine the safe maximum level of individual micronutrients which can be added to foods in Europe and thus, minimise the risk of excessive intake in those consuming very large amounts of food. Thus the common nutrient
deficiencies reported amongst the elderly by Chandra (Chandra, 2004) could all potentially be corrected by this micronutrient fortification.

A reduced functional capacity (5), cultural and psychosocial issues (6) and socio-economic status might have a large influence on food choice, and as a consequence on energy and nutrient intake in old age. It is therefore, important for food products designed for seniors to be energy and nutrient dense to compensate for likely deficiencies. To encourage the consumption of foods designed to promote long-life and well-being amongst older people in care, the importance of high quality, nutrient-dense foods needs to be emphasized. These foods must be designed to be easily consumed as part of a usual diet and contribute to enjoyment, social and cultural aspects of day-to-day living. A more diverse diet needs to be encouraged as it predicts better nutritional status (14), however, dietary quality is difficult to achieve when overall energy intake is low. Furthermore, there is a huge opening for the addition of antioxidants, to foods tailored for older people, in the attempt to avoid or reduce, age-related physical decline, and developing cataract and macular degeneration (15). Supplementation of micro-nutrients (6), anti-oxidants (15) and probiotics and prebiotics (1) is widely advocated to improve the immune response and prevent chronic disease and infection amongst older people. Such advice combined with improved sensory properties of foods consumed by older people would add life to their years.

Extreme cases of nutrient deficiency or toxicity are thought to influence taste function. This effect has been observed for vitamins A, B1, B6, B12 and folic acid and for the trace metals Zinc and Copper (16). Moreover, those nutrients are of concern in the aged. Zinc deficiency has been associated with histological changes in taste buds as well as degeneration and loss of taste papillae (17). Vitamin A deficiency results in gradual, but reversible, loss of taste, although zinc may again be involved as it plays an important role in transporting vitamin A from the liver. These findings reveal the influence nutrition has on sensory perception.

**Food intake**

A number of factors apparently influence food and energy intake amongst older people. Studies have shown that consideration of food preferences, consistency, and temperature may increase food intake (18, 19). Older persons modulate food intake by time of day, number of people present, pre-meal stomach contents, and their subjective state of hunger in a way similar to that of younger persons. Women eat more (13%) when men are present, and both
genders eat more (23%) with family present. Meals eaten in groups tend to be up to 44% larger than those eaten alone. Larger meals (10%) are eaten on weekends rather than weekdays, and larger meals are eaten later in the day (20). Provision of pleasant, well lighted, unhurried mealtimes in a social environment may increase the intake (21). During meals-on-wheels deliveries, if the person delivering the meal stays while the older person eats, nutritional risk is reduced (22). These data suggest that intake may be improved in older persons by paying attention to these sociologic factors.

A modified food guide pyramid for people over seventy years of age has been compiled by Tufts University, Boston, it is geared to help people 50 years or older and especially those 70 and older (23). The food pyramid tackles the challenge of older people’s decreased energy intake (24) and simultaneous increased nutrient requirement (10). An American study showed that total energy intake decreases substantially with age, by 1000 to 1200 kcal in men and by 600 to 800 kcal in women (25). This inevitably resulted in concomitant declines in most nutrient intakes. For this reason it is important to choose a variety of nutrient-rich foods everyday. For some nutrients, substantial numbers of older Americans consumed only one fifth to one third of the recommended dietary allowance (RDA). For most nutrients, research is lacking with which to judge the health impact of reduced nutrient consumption with age, although there is some evidence of an age-related decline in absorptive and metabolic function (25). With the aging of the population, more research is needed on nutrient requirements and health outcomes, and public health efforts are needed to increase physical activity and food intake among older people.

Based on computer models using nutrient-dense foods, experts at Tufts (23) suggested that the number of servings per food category for the 70+ Food Pyramid be modified as follows: Bread, Cereal, Rice and Pasta Group should equal or exceed 6; Vegetable Group should equal or exceed 3; Fruit Group should equal or exceed 2; Milk, Yoghurt and Cheese Group should equal or exceed 3; and Meat, Poultry, Fish, Dry Beans, Eggs and Nuts Group should equal or exceed 2. Such a dietary pattern is hypothesised to increase the likelihood that individuals with daily energy intakes of 1200 to 1600 kcal (5–6.7 MJ) will consume 100% of the RDA for protein and all essential micronutrients. It also emphasised the importance of water/liquids for older individuals, recommending 8 portions of 240ml servings per day. A flag tops the pyramid then as a reminder that again older individuals may not be getting enough vitamins
from their foods and it might be helpful to take a vitamin supplement (it recommends to consult with a health care provider first).

The Food Industry could adopt a similar approach to that of Tuft’s modified Food Guide Pyramid proposed for older people. Potentially, food manufacturers could design nutritionally balanced foods and meals encompassing the re-invented guidelines suggested for older people.

**Satiety and satiation**

Many older persons are unable to eat the same quantity of food at a single meal as they ate when they were younger. A food with a high satiety index (SI) is one, which produces a longer period of time between eating episodes during which an individual does not experience hunger. Satiety and satiation both influence the type and amount of food consumed (26). Foods or macronutrients with the same caloric value exert different effects on satiation and satiety independent of their caloric value (26). Macronutrients have been reported to effect satiety in the order of protein > carbohydrate > fat (27-29). Holt and colleagues calculated SI scores for fixed portions (240 kcal/1000 kJ) of 38 different foods, shown in Table 1 (30). White bread was used as the reference food in each group (=100%) so therefore, foods scoring higher than 100 were considered more satisfying than white bread and those under 100 were less satisfying. Holt found that some foods, like croissants, are only half as satisfying as white bread, while boiled potatoes are more than three times as satisfying, easily the most satisfying food tested. But potatoes in a different form, such as French fries, did not score well. The results of Holt's study indicate that satiety is most strongly related to the weight of the food consumed. In other words, the foods that weigh the most satisfy our hunger best, regardless of the number of calories they contain. Potatoes weighed up to four times more than the other foods with the same caloric content.

Palatability is also an important influence on both satiation and satiety because it is a primary determinant of food choice and the amount of food eaten. When the palatability of a diet is enhanced, food intake is increased both during a meal and over longer periods (31). In Holt's study, palatability ratings correlated positively with the fat and sugar contents of the foods and negatively with SI scores.

This type of information can have important implications for those wanting to increase food intake or gain weight. Based on this knowledge of satiety index, the food industry could
formulate products specifically for older people with decreased appetites or conversely enhance satiety for those whom are overweight.

Table 1. Satiety Index

<table>
<thead>
<tr>
<th>Bakery products</th>
<th>%</th>
<th>Carbohydrate-rich foods</th>
<th>%</th>
</tr>
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<tbody>
<tr>
<td>Croissant</td>
<td>47</td>
<td>White bread</td>
<td>100</td>
</tr>
<tr>
<td>Cake</td>
<td>65</td>
<td>French fries</td>
<td>116</td>
</tr>
<tr>
<td>Doughnuts</td>
<td>68</td>
<td>White pasta</td>
<td>119</td>
</tr>
<tr>
<td>Cookies</td>
<td>120</td>
<td>Brown rice</td>
<td>132</td>
</tr>
<tr>
<td>Crackers</td>
<td>127</td>
<td>White rice</td>
<td>138</td>
</tr>
<tr>
<td><strong>Snack and confectionary</strong></td>
<td></td>
<td>Grain bread</td>
<td>154</td>
</tr>
<tr>
<td>Mars candy bar</td>
<td>70</td>
<td>Wholemeal bread</td>
<td>157</td>
</tr>
<tr>
<td>Peanuts</td>
<td>84</td>
<td>Brown pasta</td>
<td>188</td>
</tr>
<tr>
<td>Yogurt</td>
<td>88</td>
<td>Potatoes, boiled</td>
<td>323</td>
</tr>
<tr>
<td>Crisps</td>
<td>91</td>
<td><strong>Protein-rich foods</strong></td>
<td></td>
</tr>
<tr>
<td>Ice-cream</td>
<td>96</td>
<td>Lentils</td>
<td>133</td>
</tr>
<tr>
<td>Jellybeans</td>
<td>118</td>
<td>Cheese</td>
<td>146</td>
</tr>
<tr>
<td>Popcorn</td>
<td>154</td>
<td>Eggs</td>
<td>150</td>
</tr>
<tr>
<td><strong>Breakfast cereals with milk</strong></td>
<td></td>
<td>Baked beans</td>
<td>168</td>
</tr>
<tr>
<td>Muesli</td>
<td>100</td>
<td>Beef</td>
<td>176</td>
</tr>
<tr>
<td>Sustain</td>
<td>112</td>
<td>Ling fish</td>
<td>225</td>
</tr>
<tr>
<td>Special K</td>
<td>116</td>
<td><strong>Fruits</strong></td>
<td></td>
</tr>
<tr>
<td>Cornflakes</td>
<td>118</td>
<td>Bananas</td>
<td>118</td>
</tr>
<tr>
<td>Honeysmacks</td>
<td>132</td>
<td>Grapes</td>
<td>162</td>
</tr>
<tr>
<td>All-Bran</td>
<td>151</td>
<td>Apples</td>
<td>197</td>
</tr>
<tr>
<td>Porridge/Oatmeal</td>
<td>209</td>
<td>Oranges</td>
<td>202</td>
</tr>
</tbody>
</table>

Adapted from Holt SHA, Brand Miller JC, Petocz P & Farmakalidis E (1995) "A Satiety Index of Common Foods," European Journal of Clinical Nutrition, 675-690. Each of the above foods was rated by how much food people ate after consuming them to satisfy their hunger. All are compared to white bread, ranked as 100%
Functional Foods

There is now more than ever an increasing need for new functionally enhanced foods to complement the existing diet of older adults (23). There is an increasing demand for products with reduced fat, salt and sugar. New technologies are required, to mask off-flavour, to re-introduce lost flavour and to rebuild texture. Moreover, the consumer seeks familiarity in sensory properties and will not be satisfied with alternatives.

Society and the food industry, currently contribute to incorrect dietary habits and dietary guidance, through a lack of understanding of the changing sensory function and its significance in regulating optimum dietary intake in older people (32).

In Europe, functional foods that specifically target the senior population are rarely seen. It is largely unknown what type of products the senior population uses. One way to collect data on functional foods purchased by older people would be to ask the food industries that produce the foods. However, not many manufacturers are willing to share information regarding their sales records and categories of buyers, since this is considered to be crucial strategic information. As a consequence, it is currently not known if and how many products are on the market, which specifically target older population. This information would be relevant to assist older people in making proper choices in the current products, or help identify specific needs that might be used by food manufacturers for new product development.

While there is a space in the market for functional foods that specifically target the older population, it is also important not to lose sight of the real goal of Nutri-Senex, which is, to improve the quality of life of older people. Is it really important that food products specifically target the older population? Or is it more important, that they are suitable while not necessarily specific and could potentially improve the nutritional status of older people?

Today's Western world is not short of food products that are nutritionally suitable for the older population, however, it may fall short of food products, which are otherwise suitable, for example, suitably packaged and labelled food products. Does the food industry really need to continue producing more and more new food products year after year or does it need to take its existing products and simply make them more suitable for older people. New functional foods are continually reaching our shops, but how beneficial are these foods? The
bioactivity and bioavailability of many functional foods needs to be addressed. Bioavailability is key to nutrient effectiveness (33). The total amount of a nutrient in a food does not reflect the amount that is available to the body through absorption, based on this definition of bioavailability it stands to reason that the addition of a nutrient or bioactive component to a food does not necessarily bring with it an added health benefit.

Moreover, although the presence of phytosterols in functional foods, such as margarines, yoghurts and drinks, serve a beneficial purpose, reducing cholesterol absorption, phytosterols have also been shown to reduce the bioavailability of β-carotene and α-tocopherol in humans (34) and of β-carotene in Caco-2 cells in culture (35). It is of utmost importance that such problems are identified and considered in the future development of food products.

The EU project ‘Process for the Assessment of Scientific Support for Claims on Foods (PASSCLAIM) (36) builds on the principles defined within the previous EU project ‘Functional Food Science in Europe’ (FUFOSE) (37). The main thrust of the FUFOSE Consensus Document was a scheme to base claims for functional foods on solid scientific evidence. FUFOSE suggested that any claim for ‘enhanced function’ and ‘reduced risk of disease’ should be scientifically justified. The FUFOSE conclusions and principles were then taken to the next logical stage, which is the identification of criteria to assess the scientific support of claims. The PASSCLAIM Consensus Document (38) contains consensus criteria to assess the scientific support for claims on foods, and will be widely disseminated among scientists, industry, consumer groups and regulators. Furthermore, PASSCLAIM will assist those making claims, those who regulate claims and it will also improve the credibility of claims for consumers.

Moreover, most studies only focus on the mechanism of action of individual bioactive food components, while relatively few studies are concerned with the interaction of the many components found in a single food. Thus, it is important to remember that functional foods rarely contain only a single bioactive component (39). For example, a great deal of research on functional foods as anticarcinogens has focused on broccoli and on a single bioactive component within broccoli, sulforaphane. The broccoli family has a unique ability to accumulate the anticarcinogen mineral selenium but when broccoli is grown in selenium rich soil, the content of sulforaphane is decreased by 80% (39). Furthermore, it is well documented that tomatoes and tomato products are a good source of the antioxidant lycopene, which play an important role in the dietary prevention of both cancer and cardiovascular
disease. However, a comparison between the effects of dietary lycopene and dietary tomato powder found that lycopene was not as effective as tomato in preventing cancer. It has been suggested that there may be additional bioactive components in the whole food that function in concert with lycopene (39). These examples of component interactions identify needed areas of study of functional foods for the food industry to focus on.

Food choices
Understanding food choice is paramount in improving the nutrition of older people. There is a good deal of evidence that the sensory characteristics of food, broadly categorized as appearance, texture, trigeminal mouthfeel, odour and taste have a very specific effect on consumer’s food choice and acceptability (40). However, it is well documented that sensory perception to food declines with age (41).

Sensory perception
Age-related deficits in taste and smell (which tend to begin around 60y of age and become more severe in persons >70y of age) have been reputed to decrease the enjoyment of food; food tastes and feels increasingly bland, leading to dietary monotony and subsequently reduced food consumption, eventually leading to malnutrition and ill health (42). Consequently, older people were found to use more spices, primarily sugar and salt contributing to an undesirable over consumption of salty and sugary food (43). Most nutritional interventions in older people do not compensate for taste and smell losses and complaints e.g. sweeteners could alternatively be used in place of sugar to enhance sweetness, and thus promote the nutritional well-being of older people (44). Mounting evidence suggests that sensory enhancement of foods with MSG and, or flavours can improve energy intake and nutritional status, improve satisfaction, reduce sodium intake and improve immune status in older subjects. The combination of MSG & flavour improved the energy intake in 40 out of 43 elderly patients in a hospital setting by 10% (45). MSG has a unique taste quality which is called ‘umami’, this Japanese word translates as meaty, savoury or delicious. Furthermore, impairment of the senses of taste and smell is one of the major factors contributing to anorexia in older people. However, anorexia often remits when food is amplified with additional odour to compensate for diminished chemosensory functioning (46). It has been suggested that nutrition experts could use MSG selectively in order to orient food selection toward a healthy diet composition. It was shown in a study carried out on a group of institutionalised elderly that the addition of MSG to target foods at lunchtime induced an
increased intake for these specific foods, with a subsequent decreased intake of foods presented later in the meal (Bellisle 1998)

Conversely, others have highlighted that enhancing the flavour of a product does not increase sample pleasantness or intake among older people (47). Given the heterogeneity of sensory function among older consumers, an increase in flavour may be an improvement for some but may prove an over-powering change for the older consumers that have maintained sensory function (48). In this regard it may prove more fruitful to focus sensory modifications on areas that maintain a more homogenous function with increased age and where modification may appeal to a wider spectrum of acceptability.

Alterations in the ability to appreciate the taste of food (most of which are due to decreased olfaction) mean that food presentation and food choice play a more important role than the actual taste of the food. In Finnish nursing homes, residents are involved in the preparation of their own food. Such an approach is further likely to decrease the complaints about food quality.

**Guidelines for sensory optimisation**

The following are guidelines for sensory optimisation of food for older people described in the HealthSense final report:

- As habits influence average liking for a product more than ageing and its associated decrease in sensory functions, the simple rule of reinforcing flavour cannot be applied without taking into account the specific food habits of older people (past and present habits).
- Similarly, as country has more impact than age on preference for a product, sensory optimisation for older people must be adapted to each country.
- Flavour enhancement has a very limited effect to increase food liking for older people.
- Flavour enhancement can be effective on a limited number of sensory attributes for older people with olfactory impairment. Nevertheless, it seems that flavour enhancement does not need to be important as the differences between the optimal levels of olfactory impaired and non-impaired seniors are rather small.
• A slight enhancement of the spicy note of sauce accompanying rice could be positive for older people with olfactory or gustatory impairment.

**Colour**

Colour also plays a key role in food choice by influencing taste thresholds, sweetness perception, food preference, pleasantness and acceptability. Colour, in a quantitative sense, has been shown to be able to replace sugar and still maintain sweetness perception in flavoured foods (49). Colour has the ability to interfere with judgements of flavour intensity and identification and in so doing has been shown to dramatically influence the pleasantness and acceptability of foods (49).

**Texture**

Changes in sensory physiology, sensory psychology and socio-cognitive factors influence food choice in ageing, for example, ageing alters saliva flow and composition, which in turn affects the ability to breakdown food, inhibits mixing, retards flavour release and makes swallowing difficult (32). Crunchy, rough, hard, crispy and dry textures are difficult for older people, while pulpy, wet, smooth and slimy textures are easier. Foods that require long chewing times also create problems (32). However, an important point to highlight is, older people’ texture difficulties does not necessarily correlate with their liking e.g. older persons find slimy, smooth and wet textures easier but find them boring as they lack textural variety and interest, in contrast they find solid crispy textures difficult but as long as they only provide initial resistance and then break down easily they are liked (32). Difficulties with eating solid foods are likely to be at their greatest in denture wearers; however, as dental care is likely to improve over time, dentures will become less common (Healthsense final report). Previous work has highlighted that modifications to food texture are inexpensive and easily applied and could provide an effective method of alleviating many of the problems associated with acceptability for certain foods among older consumers (50). Modifications to food texture have been shown to improve the liking and consumption for certain foods in older consumers (51). An improved texture may result in improved food mastication, ensuring the full profile of available flavour is released and thus precluding the need to enhance foods with additional flavours.

Findus seem to be taking the initiative by working with a food concept where the texture and nutrition is adapted to people suffering from dysphagia (52). Patients of Malmö University
Hospital underwent a therapeutic swallowing radiological examination to determine who needed texture modified food. 50 subjects were then recruited based on this examination. Participants choose two of three different dishes; 1) veal timbale, mixed vegetable timbale, mashed potatoes and wine sauce 2) chicken timbale, carrot timbale, mashed potatoes and pepper sauce 3) cod timbale, pea timbale, mashed potatoes and dill sauce. All 3 were frozen, cooked for 6-7 minutes in a microwave oven at home. The meals were nutritionally balanced, had comparable texture and plenty of sauce. The participants answered a questionnaire after the meal. The results indicated that 75% deemed the meals as very appetising or appetising. 96% deemed meals as very easy to cook or easy to cook. 76% reported the meals to taste very well or good. 89% deemed the meals as very easy or easy to eat. None of the meals were deemed as difficult to cook, eat or swallow (52). Findus successfully demonstrated the effect of texture modification on improving liking and consumption for certain foods, in older consumers with dysphagia (52). This study is an essential underpinning component of future food product development in Europe.

Guidelines on food texture
The following are guidelines on senior’ food texture preferences for the food and health sector described in the HealthSense final report:

- Ideal solid textures are those that present some resistance to biting and chewing, and give textural interest and variety. Finely pureed foods present little interest and are disliked.
- Crisp textures are well-liked by older people, and textures that present initial resistance but which break down readily in the mouth with relatively little effort.
- Textures that are hard give rise to biting difficulties, but might be managed by breaking or cutting into smaller pieces before ingesting.
- Sticky foods that adhere to the teeth and the palate are disliked.
- Foods containing peels, seeds, grains and particulates give rise to problems. These are greatest in denture wearers, but can cause problems in all older consumers.
- Foods that require a lot of preparation, such as fruit and vegetables, present problems, and pre-prepared and ready-to-eat versions should be made more widely available. Also juicy or otherwise messy foods would benefit from ready-to-eat product alternatives.
Interestingly, although the older age group regarded some texture properties as more difficult to eat than the younger age group, the results indicated that the differences between the young and the seniors in preferences were relatively small. These findings could potentially be exploited by the food industry in the development of new food products. The findings of the HealthSense project are based on studies carried out with free-living persons who have a full control over their food choices, and the recommendations presented here are aimed for non-institutionalised older people.

**Marketing**

As the European population ages at an unprecedented rate, the advertising industry will need to continue to reflect their changing needs. However, as the senior market is growing, it is getting more diverse and segmented. Not all seniors age alike, think alike or buy alike. However, with respect to marketing, older people are often aggregated into a single group without discrimination, but this can prove to be a mistake (53). Disposable income is increasing among older people, personal savings, family support and social welfare may combine to form new markets and changing demand for goods and services.

It is very important not to get the marketing and advertising of a product designed for older people wrong. Nobody wants to be reminded that they are getting older so advertising products as designed for the “elderly” may be the fastest way to position it for failure. Marketing products towards adults in general may be a better idea (53). The marketing of certain supplements towards people over a certain age (e.g. One-A-Day 50 Plus, Centrum Select 50+, Vitality 50+) may be a better strategy, as it is much easier for a seventy year old to admit to being over fifty as opposed to admitting to being elderly. Instead of fighting the consumer’s fears of growing old, rephrase “elderly” as “older” or simply make the package more attractive. Emphasize convenience of ease-of-opening and ease-of-use, this can influence an older consumer’ purchasing decisions. Furthermore, older people are concerned to some degree about their health, so it may also be better to attract their attention to a specific ailment, e.g. arthritis, instead of their age as many young people can also suffer from such problems. Marketing to the older consumer isn't based as much on the intellect, as touting the price or the benefit, but more on the emotions and building a relationship. The marketer has to build a relationship with consumers and gain their trust. For marketers and packagers this means that they must, take the time to develop a relationship, be an active listener, get to know them, find out what they like as well as what they don't like (53). Market research is
recommended, this gives older consumers the opportunity to interact with and comment on products and packages intended for them. Research shows that older people are more reliable when it comes to telling the truth.

Packaging

Although some seniors may be very active and need little assistance, many other seniors, especially those over 80, have some physical disability, which limits their ability to interact with packaging. Package providers need to keep these physical demands and limitations in mind when packaging items for seniors.

Market research indicates that glass, tin and plastic packaging cause the most problems. Screw closures and flexible packaging also seems to create problems (53). Such recommendations for packaging are important and should be applied in the food industry.

Seniors also have failing eyesight so that if there are instructions on how to open a package, they need their reading glasses, or, if you have severe cataracts; you are as good as blind. Also, as eyes age, seniors perceive colours differently, eyesight yellows, white looks yellow. Legibility is also an issue for seniors losing part of their sight. Regulations require the inclusion of more and more type on labels, yet the labels cannot expand to allow the size of the type to increase. More type means smaller point size and a greater chance seniors cannot read the labels (53).

Packagers need to pay attention to both aspects of the label, colour and type. Certain colours are easier on the eyes for people who have macular degeneration or glaucoma. Bold labels with a contrasting colour background are easier to read. Seniors are going to pay attention to the colouring, not only the colour of the package itself but also the lettering. So one has to make sure the font size is right, the colouring is right and not to put one colour on top of another (53).

Seniors tend to eat smaller portions of food, so packagers of all types of foods and beverages need to factor that into packaging equations. Re-sealable packages are extremely important to seniors with decreased appetites, even if it appears that the re-sealable item initially costs more, it can actually be more economical since the odds are the non re-sealable can would be thrown out anyway (53).
In the UK, a staggering 67,000 packaging injuries are reported in hospitals each year, costing the National Health Service over £12 million annually (54). Research has shown that such injuries are increasing, although it is clear that many injuries could be avoided by improving the design of packaging. Packaging design is normally a compromise, due to the number of functions it has to perform (55). The accidents and problems, which arise from design flaws within the packaging usually come about through this compromise. Design is an important factor in packaging, as it can be used to draw attention to the product in a competitive consumer market (56). However, designers must be aware of the importance of ergonomic factors, as inadequate attention to user capabilities can lead to dissatisfaction and accidents (56). Design flaws, leading to difficulties in opening packaging, can also lead to inappropriate tool use (such as knives or any inappropriate tool that may cause injuries). Consumers can feel forced to slash and break their way through packaging, leading inevitably to injuries.

The Netherlands Packaging Centre has been carrying out tests with older people concerning opening and re-closing packaging. The results of the experiment will be used to make a set of guidelines for designing user-friendly packaging. Further information can be attained from their website (57).

The DTI aims to help businesses understand consumer’ issues relating to packaging so that they can play their part complementing regulatory controls so that safety issues can be addressed comprehensively. In addressing these safety concerns companies can also improve their competitiveness by offering higher quality goods to consumers.

The DTI provides the following key recommendations for food businesses to make immediate improvements in packaging design (58).

**Tins**

1. Manufacturers can help by giving clear instructions for opening tins and advice on the type of opener required.
2. Retailers can assist by merchandising tin openers next to tinned products.
3. Businesses can help by making ring pulls the appropriate shape and size. (Many people think ring pulls should be bigger and not fitted so closely to the tin)
4. Retailers can help by providing appropriate tools next to the packs in stores. (Some consumers used coins, spoons and knives to lift the ring pull. Consumers liked the packs with diagrams showing how they should be opened and generally found these were clear and easy to understand)
5. Avoid tins with keys altogether.

**Glass**
6. Design packs to include texture or ridges to stop the pack slipping from the hand.
7. Lids on glass jars, especially larger diameter lids, should be fluted to improve grip.
8. Retailers should ensure that appropriate opening tools are available for consumers who require them
9. Manufacturers should review their quality control checks to ensure opening torque’s do not get unnecessarily high.

**Use of knives**
10. Industry should continue to put tear tabs on flexible plastics. These should be clearly marked and easy to remove by hand.

**Conclusion**
There is a definite need for the development of functional foods suitable for older people. An understanding of the mechanisms of food choice and acceptance is an integral part of all attempts to improve the competitiveness of the European food and drink sector. Consumer’s today are becoming increasingly discerning. On one hand, increased awareness of the contribution of optimal nutrition to the prevention of diet mediated illnesses and general feeling of well-being, has led to a demand for health promoting foods (which is desirable from an EU social and economic perspective). On another hand, increasingly active lifestyles, and now active-ageing, (which can incorporate both pleasure and work) have led to an increased demand for convenience foods. As a result of these two, somewhat opposing, demands there is a need for a new generation of health promoting designer foods (HealthSense final report). In addition, sensory preferences for intrinsic attributes of a product (provided by product composition and structure), such as texture, trigeminal feeling (e.g. spiciness), aroma and taste play a major role in overall acceptability. According to the HealthSense team, products that get these sensory attributes “right” for consumers will have
an opportunity to succeed, while products that get these attributes wrong, will fail. The consumer is the final judge of the acceptability of a food product.

In addition to sensory abilities, it has become evident that food choices in older people may be largely determined by habit, tradition, mobility, and the social context of eating and to a lesser extent by price and packaging of food (59). The challenge relating to elders for the food industry includes the development of foods where pleasure, convenience and health values converge in the same product. These values seem particularly important to older people, presumably due to health trouble, sensory losses and also due to the lack of a convenient food supply nearby. A critical mass of EU investment, and industry focus, is needed in order to understand, and then provide for, the changing needs, which accompany ageing. Failure to do so will lead to an obvious weakness, which will be filled by industry outside of Europe (HealthSense final report).

Provision of evidence is the basis for internationally agreed dietary recommendations in older people by intensified research activity in this age group. Broad dissemination of these recommendations to National policy makers, the food industry and consumers should be carried out. This review highlights the need to develop nutrient-tailored. Key nutrients include vitamins A, D, B6, B12, folic acid, calcium and trace metals Zinc and Copper. The biggest challenge is to formulate foods that are stable, safe, palatable and acceptable to the consumer. A key task is to understand the relationship between sensorial properties, physical properties of food materials and consumer preference.

This review suggests the biggest problem might lie with the marketing and packaging of products potentially suitable for older people. Packagers need to become more aware of consumer’ limitations. Design flaws lead to difficulties in opening packaging, which not only leads to inappropriate tool use but will also deter consumers from purchasing such a difficult product again. Furthermore, older persons frequently live alone and tend to eat smaller portions, so packagers need to factor this into packaging equations. It is therefore apparent that before companies select a new pack to be launched on the market that they should complete ergonomic tests to assess that packs suitability with consumers.
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