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Fruit and vegetables liking among European elderly according to food preferences, attitudes towards food and dependency

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Abstract

As the population ages and dependency for food-related activities increases, it becomes crucial to better understand food expectations of elderly consumers. Fruit and vegetables (F&V) are generally appreciated by elderly people. However, few studies have investigated elderly peoples' F&V liking, taking into account their dependency and countries' specificities. The present study aims to identify the liking of F&V, eating styles and food selectivity depending on the country of residence and levels of dependency. A European survey was conducted with 420 elderly people delegating meal-related activities, living at home or in nursing homes. Based on general food preferences, three eating styles were identified. Results showed that F&V liking is a segmenting variable. Elderly people from the style 1 (n=145) do not really appreciate fruits nor desserts. On the contrary, elderly people from style 2 (n=121) are really fruit lovers. Finally, elderly people from style 3 (n=126) liked desserts, fruits, and even more vegetables. Results showed that elderly people were nor selective towards F&V, even if there were some exceptions as exotic fruits (disliked by 19%) and fennel (disliked by 33%). Fruit and vegetables selectivity was significantly different between countries ($p<0.001$), but not between men and women, or between categories ($p>0.05$ in both cases). Selectivity for F&V was very variable and could reach 32 vegetables among 42 and 28 fruits among 34. The most selective participants were from Finland and the least ones, from the UK. These results can be used to design and/or adapt F&V-based products according to elderly consumers' liking, taking into account their country of origin and their dependency.

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1 Introduction

In Europe, population is aging: between 2010 and 2060, the part of the population over 65 years will grow from 16 to 29%, and also for elderly people aged over 80 years old, rising from 4 to 11% in the same time period (Eurostat, 2011; WHO, 2012). Beyond sociological, psychological and physiological factors, elderly appetite and food intakes also vary with their attitudes toward foods and preferences. Edfors and Westergren (2012) emphasized that: *"Meeting the need for optimal nutritional status for older people living at home requires knowledge of individual preferences and habits, from both their earlier and current lives"*. That is why proposing innovative food solutions has to be more personalized, taking into account elderly people's liking. It is relatively easy to tailor food offers according to personal preferences for autonomous elderly people. However, this is more difficult to achieve when elderly people become more dependent and delegate food related activities to caregivers (purchasing, meal preparation, etc.), and very difficult in a collective context (more dependent elderly people, living in nursing homes). Maitre et al. (2014) studied elderly people with different levels of dependency (living at home with either no help, help for non-food-related activities (cleaning, etc.), help for food-related activities (purchasing, cooking, etc.) or living in nursing homes). They highlighted that more dependent elderly people (living in nursing homes) were more selective and more at risk of malnutrition than autonomous ones (living at home without help). In a collective context, selective elderly people are harder to satisfy. Thus, a question can be raised: How could we characterise likes and dislikes of dependent elderly people? No previous comparative study about food liking and preferences has been carried out at the European level with different categories of dependency. No specific questionnaire has been developed to measure selectivity for a specific type of food.

Aging is also associated with insufficient intake of proteins (Hébel, 2012; Rousset, Patureau Mirand, Brandolini, Martin, & Boirie, 2003) and micronutrients (Elmadfa et al., 2009); which can lead to sarcopenia (Cruz-Jentoft et al., 2010), frailty and dependency (Cederholm et al.,

2014; Raynaud-Simon & Lesourd, 2000). Some other studies deal with dependency, highlighting the importance of food in this population group and the fact that the elderly are more at-risk of malnutrition (D'Antoni, Sucher, & Coulston, 1996; Gollub & Weddle, 2004).

To fight against this phenomenon, enriched and nutritionally-dense foods were conventionally developed for elderly people from functional and nutritional points of view. The sensory quality of these products and the pleasure to consume them were not considered as a priority in their development. The European project OPTIFEL (optimised foods for elderly people) aims at tackling malnutrition by developing protein enriched products which are nutritionally relevant for elderly people and well appreciated (and so, consumed with pleasure). Studies concluded that maintaining pleasure while eating is positively associated with a higher food intake or a better nutritional status (Lesourd, Raynaud-Simon, & Mathey, 2001; Maitre, 2014). Thus, it is important to choose appreciated products and to take into account elderly people's liking. On the one hand, fruit and vegetables were chosen because they are sources of vitamins, minerals and fibre (EUFIC, 2012). They are also a solution to maintain a good level of hydration. A higher consumption of fruit and vegetables is correlated to a lower risk of stroke (see He, Nowson, & MacGregor, 2006 for complete review). Fruit and vegetables are also well appreciated (Baker & Wardle, 2003) and well consumed by the elderly (Billson, Pryer, & Nichols, 1999; Juan & Lino, 2007; Monceau, Blanche-Barbat, & Echampe, 2002). However, the consumptions still remain insufficient for elderly people all over Europe (Elmadfa et al., 2009; Ruokatieto, 2015) and below the portion of 400g per day, recommended by the WHO (WHO, 2007). Moreover, bibliographic data do not indicate which fruit and vegetables are appreciated by elderly people. A better knowledge of fruit and vegetables' liking will allow adapting the offers to elderly people's appreciations.

On the other hand, fruit and vegetables represent an important part of the diet. The texture of processed fruits and vegetables can be adapted to chewing and swallowing problems of dependent elderly people. Thus, fruit and vegetables can be a good vector for protein and nutrient enrichments. A better knowledge of elderly people's fruits and vegetables liking

would reach two final objectives: 1) Better matching of fruit and vegetables with elderly people's liking in order to increase fruit and vegetables consumption and 2) Help to propose appreciated fruit-based and vegetable-based products, enriched in proteins and nutrients, in order to reduce protein and nutrients deficiencies.

This study contributes to identify fruit and vegetables liking in dependent elderly people. Despite studies on consumption frequency, to our knowledge, no previous study has investigated elderly people's liking for specific fruits and vegetables, including questions like: which fruit and vegetables are appreciated? How to cook/prepare vegetables for elderly people?

The aim of the present paper is to study attitudes towards food, eating habits, and fruit and vegetables likes and dislikes of elderly people with different levels of dependency (living at home and delegating food purchasing, living at home and delegating meal preparation and living in nursing homes, where everything is delegated). Then, this paper provides recommendations about which fruit and vegetables are appreciated in Europe. Therefore asking, can consensual products be found, according to country and dependency differences? Are there more appreciated cooking methods for vegetables?

2 Material and methods

2.1 Ethics

All participants were volunteers and gave their written agreement by signing a consent form to participate to the survey. Ethic approval was obtained from the Faculty Ethics Committee at the University of Leeds (MEEC 13-019) for the UK. All the experimental procedures used for the UK participants followed the rules and guidance set by the University of Leeds, the UK.

2.2 Participants

In 2009, Elmadfa et al. divided Europe in four regions (North, Central East, West and South) and showed that fruit and vegetables are more available in the South region. Thus, culture or availability across Europe may affect fruit and vegetables liking. So, in our study, data was collected from five countries to represent each region: Finland for North, Poland for Central East, France and UK for West and Spain for South.

Participants were recruited following three inclusion criteria: the age, the level of food dependency and the cognitive status. Regarding the age, elderly people between 65 and 98 years old were recruited (see Figure 1). Three categories of food dependency, inspired from Sulmont-Rossé et al. (2015) were defined. The first category involved participants living at their home and needing help for food purchasing. In the second category, participants lived at home and needed help for meal preparation. Data from the Aupalesens survey showed that a category including delegating meal preparation and meals-on-wheels was homogenous enough to be significantly different from people needing help but not for food-related tasks and from people living nursing homes. Thus people with meals-on-wheels were also included in this category. The third category included elderly people living in nursing homes, where food related activities (purchasing and preparation) were completely delegated to the nursing homes staff. This category was considered as the most food dependent one. People eating mixed-food were not included. Finally, three questions from the Mini Mental State Examination test (Folstein, Folstein, & McHugh, 1975) were used as inclusion criterion (“What is the year?”, “What is the season?” and “What is the month?”). Participants were required to have, at least, 2 out of 3 correct answers. A total of 420 Elderly people were recruited and interviewed.

2.2.1 Mini Mental State Examination

Cognitive status of participants was assessed using the Mini Mental State Examination (MMSE) questionnaire (Folstein et al., 1975). This questionnaire gathers 30 items, split in 6 dimensions: orientation, registration, attention and calculation, recall, language and motor skills. Participants with scores strictly lower than 21 were excluded from final data analysis

(Laureati, Pagliarini, Calcinoni, & Bidoglio, 2006). This assures that participants were cognitively able to answer questionnaires.

2.2.2 Health and Taste Attitude Scales

Attitudes towards foods were measured according to the Health and Taste Attitude Scales (HTAS) questionnaire adapted from Roininen, Lähteenmäki, & Tuorila (1999). The 7-point scale (from “disagree strongly” to “agree strongly”) originally developed on non-elderly people, was adapted for elderly people and reduced to a 4-point scale: “disagree”, “rather disagree”, “rather agree” and “agree”. Three dimensions were selected from the questionnaire: health interest (8 items), natural product (6 items) and pleasure (6 items). As proposed by Roininen et al. (1999), negative statements were reversed and recoded for the final score calculation. The final score is the mean between each item score within dimensions. It varies from 1 (not interested in) to 4 (interested in) for each dimension.

2.2.3 Food Neophobia Scale

Food neophobia is “a reluctance to eat and/or avoidance of novel food” (Pliner & Hobden, 1992). It was measured using the Food Neophobia Scale (FNS) questionnaire (Pliner & Hobden, 1992). The original 7-point scale (from “disagree strongly” to “agree strongly”) was adapted for elderly people and reduced to 4 points: “disagree”, “rather disagree”, “rather agree” and “agree”. As proposed by Pliner & Hobden (1992), negative statements were reversed and recoded for final score calculation. The final score varies from 10 (not neophobic) to 40 (very neophobic).

2.3 Questionnaires about foods, fruit and vegetables

2.3.1 Eating styles

Global food preferences and habits were evaluated using a questionnaire based on the AUPALESENS survey (Maitre et al., 2012), however adapted to be more fruit and vegetables specific. The questionnaire was composed of 21 items: eight frequency items (frequency of

drinking alcohol during meals, frequency of salt addition, etc.), nine liking items (liking levels of desserts, meat, fruits, etc.), two preference items (preference for fish / meat, preference for cooking with oil/cooking with butter) and two quantity items (consumed quantity of bread and soup). Participants were asked to rate their level of agreement between two opposite items according to a 5-point Osgood's semantic differential scale. For instance: "I am used to eating very little soup" (1) – "I am used to eating a lot of soup" (5).

2.3.2 Selectivity towards fruit and vegetables

Maitre et al. (2014) proposed a rapid questionnaire to measure food selectivity in the elderly and showed a link with malnutrition risk. This heuristic list included both raw and cooked food (71 items) where interviewed elderly people had to tick items they dislike. In our survey, the questionnaire was adapted to be fruit and vegetables specific. A new 76-item list was created and included familiar fruits and berries (raw or processed), vegetables (raw or processed), starchy foods (such as potatoes), mushrooms and culinary herbs (such as sorrel and parsley). The complete list is presented in appendices A. Despite the number of items, the selectivity questionnaire was very rapid to administer (2-3 minutes). The experimenter individuating listed items orally and the participant indicated disliked or unknown products. In this case, the experimenter ticked the corresponding item on the questionnaire. In definitive, it is very rapid and not cognitively demanding for elderly participants. Special attention was paid to distinguish between "I do not like the product" and "I cannot eat the product anymore (because of teeth, intestinal, special diet, etc. issues). Finally, the selectivity score is the number of disliked items multiplied by 100 and divided by the number of known items. The higher the score was, the more selective the participant was.

2.3.3 Liking of different cooking methods for vegetables

Vegetables can be prepared and eaten in different forms: raw, boiled, processed into soup, etc. Thus, we investigated the appreciation of different vegetable cooking methods. Participants had to rate their appreciation on a 5-point scale from 1 (totally dislike) to 5 (like a

lot), where 3 meant “indifferent”. Eight different cooking methods for vegetables were explored: steam cooked, fried, raw, gratin, baked, braised, plain boiled and in processed soup.

2.4 Data analysis

ANOVA and LSD post-hoc analysis were computed with Statgraphics Centurion XVI (version 16.1.03) and R software (version 3.1.2). Sample sizes varied between analyses due to invalid or missing data. Non-significant interactions were removed from the ANOVA models. To categorise subjects according to their eating styles, a cluster analysis was performed on the eating style questionnaire (21 items about global food preferences and habits), using a hierarchical ascending classification (Euclidean distances, Ward criterion), consolidated by K-means algorithm with R software. Then, descriptions of styles were made using the “catdes” procedure in R (package *FactoMineR*). In this procedure, mean scores (for each style) were compared to general mean scores (all styles together) by a t-test. All questions were used for clustering, except the one about deli products due to missing data from the UK. Participants with missing data (n=13) were also removed from clustering. Finally, Khi^2 and Khi^2 per cell were used to compare frequencies, using R software.

3 Results

3.1 Participants

To assess cognitive status, participants were selected using the Mini Mental State Examination test. Elderly people with a MMSE score equal or higher than 21 were included and others (n=15) were excluded from the data analysis. Final dataset includes 405 elderly people, composed of 314 females and 91 males. Mean age is 82 ± 7 years old. Table 1 describes the sample characteristics, detailed by country and categories of food dependency. As shown in Figure 1, ages were homogeneously dispersed in the 3 categories.

Table 1 about here

Figure 1 about here

3.2 Eating styles

Using hierarchical cluster analysis (eating style questionnaire: 21 items about global food preferences and habits), three eating styles were identified. Table 2 shows scores of each item used for hierarchical cluster analysis while descriptive variables for the three eating styles are summarized in Table 3.

3.2.1 Style 1 (n=145)

In this cluster, elderly people did not really appreciate fruit and vegetables in any form such as soups, vegetable purées as well as pieces of fruit or vegetables in purées. They rarely seasoned their meal with spices or herbs and could easily have meals without a dessert. Participants consumed wine and beer more frequently during meals than in the two other clusters. In general, they liked ready-to-eat dishes, deli products and cooking with butter.

Cluster 1 included more men than other clusters (30%), had a higher proportion of French (34%) and English (33%) participants but without any specific representation of one of the three categories. They were in general also less interested by health and natural aspects of foods (lower HTAS scores).

3.2.2 Style 2 (n=121)

People from cluster 2 enjoyed eating fresh fruits (including berries). They also liked eating fruit and vegetables in different processed forms such as fruit purees, vegetable soups and preferred soups with pieces. They preferred cooking with oil than with butter. They regularly seasoned their meals with salt, spices and herbs. It is worth recognizing that they declared very rare wine or beer consumption during meal. They did not appreciate ready-to-eat dishes, deli products, as compared to participants from the two other styles. They rarely

added sugar to their yoghurts, could easily have meals without a dessert and did not consider themselves that much as red meat lovers.

Participants clustered in this eating style were mainly Finnish (26%) and Polish (38%) elderly people. Regarding dependency categories, there were more participants from category 1 (help for food purchasing, 50%) and less from category 3 (living in nursing homes, 14%). They were more interested by health and natural aspects in foods (the highest HTAS scores).

3.2.3 Style 3 (n=126)

In this cluster, elderly people were found to be very fond of desserts and clearly preferred cooking with oil cooking to cooking with butter. They enjoyed fruits, soups, vegetables and vegetable purees a lot. They also considered themselves as meat lovers. However, they did not really appreciate ready-to-eat dishes, as in eating style 2. They used sauces less frequently and seasoned rarely their meals (with salt, spices and/or herbs), as compared to the participants from other two styles. They declared to eat more soup than the other participants.

Majority of the participants identified in this eating style were Spanish (47%). They were mainly from category 3 (living in nursing homes, 39%).

Table 2 about here

Table 3 about here

Due to major differences in general food likings and habits (people from style 2 have a more fruit-oriented liking while people from style 3 have a fruit and even more vegetable-oriented liking).

3.3 Selectivity towards fruit and vegetables

227 Results showed that many factors influence the selectivity score: food neophobia, attitudes
228 towards foods (natural aspect) and country (see Table 4 for F and p values). Post hoc
229 analyses showed that elderly people were more selective when they were more neophobic
230 and more interested in natural aspects of foods. No overall dependency category effect was
231 found ($F_{(2, 392)}$=1.168, $p > 0.05$) According to post-hoc analysis, Finnish participants appeared
232 to be the most selective.

233 *Table 4 about here*

234 3.4 Liked and disliked fruit and vegetables

235 The questionnaire related to the fruit and vegetables selectivity gave quantitative information
236 on selectivity levels of elderly people and also qualitative information on which fruit and
237 vegetables were liked or disliked. Results showed that, in general, fruit and vegetables
238 proposed in the list were well known. However, some items were unknown by more than
239 20% of the participants (chestnut, quince jelly, pomelo, chicory, artichoke, chickpea, spinach
240 in salad, sweet potato and endive). Pomelo and endives appeared to be the most unknown
241 fruit and vegetable (unknown by respectively 35% and 32% of participants).

242 *3.4.1 Liked and disliked fruits*

243 Fruits (34 items) were mainly appreciated by at least 90% of the elderly (Figure 2).
244 Independently from country specificities, less than 5% of the participants declared disliking
245 peach, plum, apple, pear, strawberry, orange, clementine, raspberry, mandarin, banana,
246 apricot, nectarine, cherry and pineapple. So those fruits were well accepted by a majority of
247 elderly people. On the contrary, some others fruits were less appreciated by more than 10%
248 of the participants; which included quince jelly, chestnut, exotic fruit juice, pomelo, mango
249 and kiwi. Per country results showed wide variations. For example, 41% and 29% of
250 participants declared disliking chestnut in Finland and Poland, respectively. However, in
251 Spain, France and United Kingdom, only 3%, 7% and 7% of the elderly people declared
252 disliking chestnut, respectively. Results detailed per country and dependency category are

showed in Table 5. Interesting differences can be noticed between the three categories. Chestnut was less rejected in nursing homes (8% of the participants), compared to people from category 1 and 2 (14% and 13% for respectively). On the contrary, kiwi, mango and watermelon were more frequently rejected in nursing homes than in the two other categories. Exotic fruit juice appeared to be relatively accepted by people from category 1 and 3 (11% and 12% of participants declared disliking it), but less by elderly people from category 2 (22% of participants declared disliking it).

Figure 2 about here

Table 5 about here

3.4.2 Liked and disliked vegetables

Regarding vegetables (42 items), there were more people disliking vegetables than people disliking fruits (Figure 3). Only 5% or less of the interviewed elderly people declared disliking potatoes, parsley, green peas, raw lettuce, and green cabbage. So it can be concluded that these vegetables were well accepted by the majority of interviewed elderly people. The most disliked vegetables, for at least 20% of the population, were chicory, turnip, sweet corn, lentils, artichoke, aubergine fennel and spinach in salad. As for fruits, there was an important variability within each country. For example, 46%, 47% and 55% of participants declared disliking artichoke, in the UK, Poland and Finland, respectively. However, in France and Spain, only 2% and 3% of the elderly people declared disliking artichoke. Results detailed per country and dependency category are shown in Table 6. Interesting differences can be noticed between the three categories. Leeks were less rejected by people from category 1 (6%) than by people from category 2 (18%) and 3 (14%). The same effect can be observed for turnip (category 1: 12%, category 2: 25%, category 3: 24%). However, asparagus, artichoke and aubergine were less rejected in category 3 (8%, 12% and 13% respectively) than in category 1 (17%, 26% and 28% respectively) and category 2 (16%, 25% and 28% respectively).

Figure 3 about here

Table 6 about here

3.5 Liking of different vegetables cooking methods

Vegetable liking was significantly influenced by country ($F_{(4, 3240)}$=64.74, p<0.001), cooking methods ($F_{(7, 3240)}$=17.99, p<0.001) category ($F_{(2, 3240)}$=13.38, p<0.001), country x cooking methods ($F_{(28, 3240)}$=7.77, p<0.001) and category x cooking methods ($F_{(14, 3240)}$=1.82, p<0.05). Mean liking scores were generally high in all countries (about 4/5 or higher), but about 3.6/5 in the UK. Regarding cooking methods, braised, plain boiled and vegetable soups were the most appreciated (mean liking scores higher than 4.1/5).

Those cooking methods could be considered as consensual for most of the elderly people in all interviewed countries (Figure 4). Despite statistical significant differences, it is worth noting that in all three categories all the cooking methods were well appreciated (mean liking notes higher than 4/5 in general and higher than 3.8/5 for each cooking method – Figure 5).

Figure 4 about here

Figure 5 about here

All cooking methods appeared to be quite appreciated either in all countries or in all categories (with exceptions for UK where liking is more moderated).

4 Discussion

The present study provides data on liking of culinary-dependent elderly people, in five different European countries. Results show both: consensus between the elderly about a good level of fruit and vegetables liking and no rejection of any cooking method, and at the same time, a high variability in food styles. Previous studies have shown that fruit and vegetables were globally appreciated by elderly people and also more consumed as

compared to younger adults (Baker & Wardle, 2003; Juan & Lino, 2007; Monceau et al., 2002). However, those studies did not show the variability existing in the elderly population. We identified three eating styles with specific food preferences. Most of the participants from style 2 were fruit oriented, and most participants from style 3 were vegetable oriented. On the contrary, most of the participants from style 1 were rather indifferent to fruit and vegetables (except for vegetable purees). Eating styles are in accordance with attitudes towards foods. People from eating style 2 were more interested by health and natural aspects in foods (higher HTAS scores). These attitudes towards foods are congruent with their declared liking, preferences and clearly highlight health awareness. Influence of attitudes towards foods on fruit and vegetables liking was not investigated in great detail. Though, our results did not highlight any link between neophobia and eating styles. In a recent study with 292 Finnish twins (21-25 years old), Törnwall et al. (2014) showed that preferences for fruit and vegetables were not influenced by HTAS (health interest) but by food neophobia: less neophobic participants had a higher preference for fruit and vegetables. All these results are arguing for the complementarity of the methods.

The fact to be selective in food choices, also known as “pickiness” or “fussiness”, was documented mainly in children and very rarely with the elderly. As food selectivity is a relatively new research theme, very few studies have been done for elderly people and validated questionnaires have to be developed (Dovey, Staples, Gibson, & Halford, 2008). In this study, a rapid questionnaire was adapted to evaluate selectivity towards fruit and vegetables. It consisted in a specific list of different fruits and vegetables. Using this easy questionnaire and conducting a rapid interview enabled to deliver quantitative as well as qualitative results. Results showed that the participants more selective towards fruit and vegetables were more food neophobic, more interested in natural aspects of foods and Finnish. Selectivity and food neophobia appeared to be linked; which is in agreement with the studies reviewed by Dovey et al. (2008). It also supports previous findings that elderly people preferred “traditional” preparations as first courses and liked less “unfamiliar” dishes

(Laureati et al., 2006). Finnish participants appeared to be the most selective. In Northern Europe, fruit and vegetables are less available than in Southern Europe (Elmadfa et al., 2009). Thus, we can assume that geographical position can induce differences in terms of quantity, variety and/or quality. So, the first hypothesis is that a higher selectivity in Finland could be due to a larger number of unknown products in the marketplace. However, to tackle this effect, participants had the possibility to indicate if they knew the item or not. If the item was unknown, it was excluded from the selectivity score calculation. The second hypothesis is that, due to the increasing demand, some fruit and vegetables (such as exotic ones) may have recently appeared on the market shelves (from the elderlies' point of view). Thus, they are relatively new and not really attractive for elderly people. This is linked to food neophobia and in accordance with our results, showing that the most selective elderly were also the most neophobic, irrespectively of the country specificities. Causes of selectivity in elderly people according to dependency need further investigation.

Combining eating styles and selectivity information provided knowledge on which fruit and vegetables were liked or disliked by participants. Knowing elderly people's expectations and preferences can help maintain pleasure while eating. Previous studies have shown that maintaining pleasure while eating is positively associated with a better nutritional status or a higher food intake (Lesourd et al., 2001; Maitre, 2014). However, it is worth noting that the questionnaire was about the disliked fruit and vegetables and not a questionnaire about what can be or is actually consumed. To get complete information about the elderly needs, nutritional and function needs have to be explored in addition to sensory expectations.

5 Conclusions

This study adapted methods to characterise the needs and expectations of elderly people when becoming more dependent and to measure their liking and selectivity levels regarding fruit and vegetables. Results showed that the eating styles and the selectivity questionnaires constitute two discriminant tools, while the cooking methods questionnaire is less. They can

help to make a “profile” of dependent elderly people regarding fruit and vegetables liking and consumption in order to better match food offers and their liking. Regarding fresh or processed fruit and vegetables, they were globally well appreciated by elderly people. We highlighted fruit and vegetables that were consensual in all five European countries and all categories of dependency; and less appreciated ones, by at least 20% of the interviewed elderly (exotic fruit juice, pomelo, mango, kiwi, chicory, turnip, sweet corn, lentils, artichoke, aubergine fennel and spinach in salad). Regarding vegetables, all cooking methods were relatively well appreciated. All these results can serve as a support for designing new products. In context of malnutrition, our results could help food industries to choose the relevant fruit/vegetable matrix for nutrient and protein fortified foods (soups for example). This is important for developing more personalized fruit-based and vegetable-based products for elderly consumers in order to design new food products tailored to their expectations and enabling adequate maintenance of nutritional intakes, appetite and pleasure while eating.

6 Appendices

Appendices A: Questionnaire to measure fruit and vegetables selectivity in elderly people

Food	I dislike	I do not know
Leeks		
Lentils		
Cooked carrots		
Grated Raw carrots		
Green beans		
Potatoes		
Courgettes		
Sweet pepper		
Artichoke		
Eggplant		
Endive		
Broccoli		
Celeriac		
Cultivated mushroom		
Green cabbage		
Cauliflower		
Cooked spinach		
Spinach in salad		
Fennel		
Dried beans		
Raw lettuce		
Sweetcorn		
Turnip		
Onion		
Sorrel		
Green peas		
Pumpkin		

Radish
Raw tomato (in salads)
Cooked tomato
Cooked red beetroot
Cucumbers
Avocado
Melon
Asparagus
Fruit compotes
Fruit pies
Cake with fruits
Apricot
Pineapple
Banana
Black currant
Cherry
Clementine
Strawberry
Raspberry
Gooseberry (redcurrant)
Kiwi
Mango
Blackberry
Blueberry
Hazelnut
Nut
Orange
Peach
Peer
Pomelo
Apple
Plum
Orange juice
Apple juice
Exotic fruit juice
Almond
Broad bean
Brussels sprouts
Chestnut
Chickpea
Chicory
Garlic
Mandarin
Wild mushrooms
Nectarine
Parsley
Quince jelly
Sweet potato
Watermelon

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8 References

Baker, A. H., & Wardle, J. (2003). Sex differences in fruit and vegetable intake in older adults. *Appetite*, *40*(3), 269–275.

Billson, H., Pryer, J. A., & Nichols, R. (1999). Variation in fruit and vegetable consumption among adults in Britain. An analysis from the dietary and nutritional survey of British adults. *European Journal of Clinical Nutrition*, *53*(12), 946–952

Cederholm, T., Nouvenne, A., Ticinesi, A., Maggio, M., Lauretani, F., Ceda, G. P., … Meschi, T. (2014). The role of malnutrition in older persons with mobility limitations. *Current Pharmaceutical Design*, *20*(19), 3173–3177

Cruz-Jentoft, A. J., Baeyens, J. P., Bauer, J. M., Boirie, Y., Cederholm, T., Landi, F., … Zamboni, M. (2010). Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. *Age and Ageing*, *39*(4), 412–423.

D'Antoni, G. B., Sucher, K. P., & Coulston, A. M. (1996). Dietary Intake of At-Risk, Free-Living, Elderly Subjects Receiving Meals-on-Wheels and a Dietary Supplement. *Journal of the American Dietetic Association*, *96*(9), A79

Dovey, T. M., Staples, P. A., Gibson, E. L., & Halford, J. C. G. (2008). Food neophobia and "picky/fussy" eating in children: A review. *Appetite*, *50*(2–3), 181–193

Edfors, E., & Westergren, A. (2012). Home-Living Elderly People's Views on Food and Meals. *Journal of Aging Research*, *2012*, 1–9

Elmadfa, I., Meyer, A., Nowak, V., Hasenegger, V., Putz, P., Verstraeten, R., … Margetts, B. (2009). *European Nutrition and Health Report 2009*. *European Nutrition and Health Report 2009* (Vol. 62). Basel: KARGER

EUFIC. (2012). Fruit and vegetable consumption in Europe – Do Europeans get enough? Retrieved December 8, 2015, from http://www.eufic.org/article/en/page/RARCHIVE/expid/Fruit-vegetable-consumption-Europe/

Eurostat. (2011). Structure et Vieillissement de la population. Retrieved March 26, 2014, from http://ec.europa.eu/eurostat/statistics-explained/index.php/Population_projections

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-mental state: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, *12*(3), 189–198

Gollub, E. A., & Weddle, D. O. (2004). Improvements in nutritional intake and quality of life among frail homebound older adults receiving home-delivered breakfast and lunch. *Journal of the American Dietetic Association*, *104*(8), 1227–1235

He, F. J., Nowson, C. A., & MacGregor, G. A. (2006). Fruit and vegetable consumption and stroke: meta-analysis of cohort studies. *The Lancet*, *367*(9507), 320–326

Hébel, P. (2012). Evolution de la consommation de viande en France Les nouvelles données de l'enquête CCAF 2010, 1–4

Juan, W. Y., & Lino, M. (2007). *Fruit and Vegetable Consumption by Older Americans*. *Nutrition Insight* (Vol. 34), 64–65

Laureati, M., Pagliarini, E., Calcinoni, O., & Bidoglio, M. (2006). Sensory acceptability of traditional food preparations by elderly people. *Food Quality and Preference*, *17*(1-2), 43–52

Lesourd, B., Raynaud-Simon, A., & Mathey, M. F. (2001). Comment favoriser la prise alimentaire des sujets agés. In *Nutrition Clinique et Metabolisme* (Vol. 15, pp. 177–188)

Maitre, I. (2014). *Perceptions sensorielles et préférences alimentaires des seniors - Contribution au maintien du statut nutritionnel et à l'appréciation des produits*.

Maitre, I., Amand, M., Cariou, V., Van Wymelbeke, V., Sulmont-Rossé, C., & Vigneau, E. (2012). Tell me what you are eating, I will tell you who you are: the different eater styles among the elderly population. *5. European Conference on Sensory Consumer Science of Foods and Beverages. A Sense of Inspiration*. Bern, Switzerland

Maitre, I., Van Wymelbeke, V., Amand, M., Vigneau, E., Issanchou, S., & Sulmont-Rossé, C. (2014). Food pickiness in the elderly: Relationship with dependency and malnutrition. *Food Quality and Preference*, *32*, 145–151

Monceau, C., Blanche-Barbat, E., & Echampe, J. (2002). La consommation alimentaire depuis quarante ans : De plus en plus de produits élaborés. *Insee premières (846),* 1–4

Pliner, P., & Hobden, K. (1992). Development of a scale to measure the trait of food neophobia in humans. *Appetite*, *19*(2), 105–120

Raynaud-Simon, A., & Lesourd, B. (2000). Malnutrition in the elderly. Clinical consequences. *La Presse medicale*, *29*(39), 2183–2190

Roininen, K., Lähteenmäki, L., & Tuorila, H. (1999). Quantification of Consumer Attitudes to Health and Hedonic Characteristics of Foods. *Appetite*, *33*(1), 71–88

Rousset, S., Patureau Mirand, P., Brandolini, M., Martin, J.-F., & Boirie, Y. (2003). Daily protein intakes and eating patterns in young and elderly French. *British Journal of Nutrition*, *90*(06), 1107–1115

Ruokatieto. (2015). *FORKFUL OF FACTS - Finnish Food Industry Statistics*. Retrieved December 10, 2015 from http://www.ruokatieto.fi/sites/default/files/Ruokafakta/Tietohaarukan taulukot/tietohaarukka2015_englanti.pdf

Sulmont-Rossé, C., Maître, I., Amand, M., Symoneaux, R., Van Wymelbeke, V., Caumon, E., … Issanchou, S. (2015). Evidence for different patterns of chemosensory alterations in

the elderly population: impact of age versus dependency. *Chemical Senses*, *40*(3), 153–164

Törnwall, O., Silventoinen, K., Hiekkalinna, T., Perola, M., Tuorila, H., & Kaprio, J. (2014). Identifying flavor preference subgroups. Genetic basis and related eating behavior traits. *Appetite*, *75*, 1–10

WHO. (2007). *European Action plan for food and nutrition policy 2007-2012*. Retrieved December 13, 2015, from http://www.euro.who.int/__data/assets/pdf_file/0017/74402/E91153.pdf

WHO. (2012). 10 facts on ageing and the life course. Retrieved October 28, 2015, from http://www.who.int/features/factfiles/ageing/en/index.html