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Sommario

NUTRITIONAL PROPERTIES OF DIFFERENTLY PROCESSED FOODS FOR INSTITUTIONALIZED ELDERLY PEOPLE

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ABSTRACT

In cooperation with the Local Healthcare Agency No. 1 "Triestina", the quality of food provided in the canteens of four multifunctional facilities in the Province of Trieste dedicated to the not entirely self-sufficient and completely not self-sufficient elderly (two residential care homes and two private care homes) was considered. This assessment represents the first necessary step to understanding whether elderly institutionalization may be a factor predisposing, precipitating or aggravating the status of a possible malnutrition. Most of the food products consumed in the examined canteens were of significantly lower quality compared to the products commonly found on the market. In particular, by detecting secondary oxidation products, a considerable p-anisidine index, higher than 10 for more than 20% tested samples (fat based foods) was found. In addition, the amount of polyphenols, per person, potentially ingestible with meals, hardly reached 150 - 200 mg/day and the vitamin content was generally lower with respect to reference nutritional values established by INRAN.

Keywords: healthcare, canteens, multifunctional facilities, elderly, antioxidant activity, polyphenols, fats, p-anisidine, Folin Ciocalteu, ABTS, vitamin A, vitamin C, niacin.

INTRODUCTION

Human body aging implies significant metabolic and physiological changes, such as decrease of basal metabolism, deterioration of renal and hepatic functions, as well as malabsorption of micro and macro nutrients by intestine. It is important to consider that some changes in nutrient metabolism can be ascribed to the use of pharmaceutical drugs, which is increasingly common in aging people. Senior citizens are particularly vulnerable to poor diet, however the attempt to improve the level of their nutrition often crashes with many practical problems. One difficulty in relation to nutritional needs is that they are not clearly identified. Indeed, as already mentioned, aging itself is one of those factors influencing people’s nutritional needs. Therefore, some nutrients could be less necessary, whereas some others could be more necessary with the aging process. It is, therefore, important to constantly review the data concerning the daily nutritional need of this age group, and for the national authorities to ask the World Health Organization new guidelines. Moreover, a number of those diseases which frequently affect elderly people, like neuro-degenerative and cardiovascular diseases, diabetes, osteoporosis and cancer, are the result of nutritional habits which people have been playing for years. Therefore a healthy and balanced nutrition is fundamental for the prevention of some chronic diseases and could be considered as adjuvant therapy by all means. Micronutrients and protective substances must be included in a healthy diet, as they lack in old people because of malnutrition or unvaried diet. At the same time, what can have an impact on old people’s malnutrition is definitely the food cost, leading to a reduction of those rich with micronutrients (for example fruits and vegetables) and to an increase of those with macronutrients of low quality (especially sugar and fat). This is estimated to be one of the causes for increased mortality among old people (Lo et al. 2012). These habits are often coupled by a cognitive loss and problems of self-sufficiency, which can hamper adequate nutrition previously performed. Nowadays almost 22% of Italian population is represented by individuals aged over 65 years, and it is estimated that this figure will increase to 33% in 2050 (ISTAT). The trend will imply problems in management, health care and economy, because only a portion of elderly people is autonomous and self-sufficient. Families are often unable to guarantee appropriate care and Health and Assistance Residences or retirement homes are a good option for those who need particular assistance. Since institutionalization is considered inducing, rousing or aggravating the state of malnutrition, this study was designed to evaluate the quality of food supplied to elderly people living in multifunctional facilities in the Trieste Province.

BACKGROUND

Aging is strongly influenced by wrong nutrition, which contributes to different diseases (Zangara & Bianchi 1991), and consequently nutritional interventions are designed not only to maintain nutritional levels in patients with the right diet but also to have a therapeutic role in patients with wrong diet or at risk of malnutrition. Malnutrition caused by lack of nutritional provision is registered among institutionalized elderly people at alarming levels, between 23 and 85%, often for different reasons (Bellini 2009). One of the causes of old people malnutrition in nursing homes, and their subsequent refusal to eat, is that food is always the same. This leads to the consumption of food with low nutritional value, lacking vitamins and mineral salts, but rich of fat and proteins with low biological value (Lombardo 2009). Changes in diet are definitely important because they seem to influence older people more than the general population, where the increase of fruits and vegetables consumption from one to two portions a day is estimated to reduce the risk of cardiovascular diseases by 30% (WHO).

MAIN FOCUS OF THE PAPER

Aim, Issues, Controversies, Problems

Ministry of Health data showed differences in nutritional levels not only among Regions, but also among different residencies within the same Region. Differences related to food distribution, and the level of education and awareness of professionals regarding the role of nutrition in health promotion. For this reasons guidelines for nursing homes on nutrition and structural requisites have been drafted, as well as guidelines for food coming from external service (Ministry of Health 2011). The aim of this study is a preliminary evaluation of the food quality provided in four residencies, two residential care homes and two private care facilities for older people partly self-sufficient and completely non self-sufficient, located in the Trieste province. Different analyses were performed in relation to different foods, specifically a) the evaluation of polyphenol content, of anti-oxidant capacity and of vitamin content for vegetable products b) the evaluation of total lipids and the p-anisidine value for meat and fish products c) the evaluation of acidity, the number of peroxides and the p-anisidine value for oils.

Method or Approach

Sampling
The food samples were taken before lunchtime in four nursing homes of Municipality of Trieste. Samples of vegetables (peas, carrots, beets, spinach, broccoli, cauliflower, prepared soups, fresh soups etc), meat (hamburgers, meatballs etc) and fish (fillets, sticks etc) were collected and two samples sets were obtained. The first was represented by the samples of preserved frozen food, whereas the second was given by both frozen foods and preserved and cooked foods. In addition, oil samples were collected. In total 99 samples were collected over three months. The samples not immediately analyzed were kept in a freezer at -80° C.
Sample chemical analysis
Determination of total polyphenol content
For the determination of the polyphenols it has been used the colorimetric Folin-Ciocalteau method based on the addition of a reagent capable of assuming a blue colour, whose intensity is proportional to the number of phenolic compounds (Singleton et al. 1999).
Determination of antioxidant activity

ABTS method (Re et al. 1999) was chosen since it is direct, stable, easily reproducible and widely applied on matrices of plant origin. In this method, the concentration in the final reaction media that causes a decrease in the initial absorbance by 50% is defined as IC50. In this paper the antioxidant capacity was expressed as antiradical power (ARP), defined as 1/IC50.

Determination of total fat

The quantitative lipid profile of meat and fish samples was determined. A known amount of each sample was lyophilized and consequently 15 g of lyophilized was subjected to ethanol extraction using Soxhlet apparatus.

Determination of the peroxide and acid index

In oil samples the oxidation state was determined by using peroxide value. The free acidity was determined and expressed as a percentage of oleic acid. Both analyzes were conducted according to the method indicated in the implementing Regulation EU n.299/2013 (EU 2013)

Determination of anisidine value

In samples of oils and lipid extracts obtained from meat and fish foods, the p-anisidine value (AV) was determined. This parameter provides an indication of the state of the secondary oxidation of lipids, and thus of the possible aldehyde formation, including acrylamides. Studies on correlation between AV and organoleptic quality of fats have pointed out the effectiveness of this analysis in several lipid substances. (M. Laguerre et al. 2007).This test was carried out using instruments and methods in compliance with the Official Pharmacopoeia of the Italian Republic (Official Pharmacopoeia 2008)

HPLC determination of vitamins

Niacin: an aliquot of aqueous extract was injected into C18 column (5μ, 4.4 mm ID x 250mmL). Mobile phase: water/methanol/ hydrochloric acid 95/4/1 (v/v) %. Isocratic flow rate: 1.5 mL/min. Detection: UV/DAD set at-245 nm. Vitamin C: before injecting aqueous extract was derivatized with dithiothreitol (DTT). For chromatographic conditions see above (niacin section) except mobile phase: aqueous sulphuric acid 0.01% (pH=2.6).Vitamin A: the lipophilic extract was processed with petroleum ether and an aliquot was injected into C18 column (5μ, 4mm ID x 250mmL). Mobile phase: methanol/water 95/5/ (v/v) %. Isocratic flow rate: 2 mL/min. Detection: UV/DAD set at-325 nm.

RESULTS AND IMPLICATIONS

Table 1 (for need of brevity some analyzed samples are not listed) shows the data relative to the polyphenol content, antioxidant power and vitamins. It is possible to note significant differences in polyphenol content due to both the nature of food (vegetables, proteins, etc.) and processing technologies (fresh, frozen, cooked, etc.). Canned vegetables showed fairly homogeneous polyphenolic content. The analysis of frozen carrots has highlighted the low concentration of polyphenols in baby carrots and a reduction of such content as regards frozen sliced carrots. This can be justified by the fact that the cut induces an initial increase of polyphenols, followed by a subsequent decrease owing to the activation of the polyphenol oxidase (PPO). Frozen soup mix gave results ranging from 1.5 to 4μg/g, but overall lower than the individual vegetables. Also in this case, the reason may be caused by the food preparation step (washing and cutting) which can determine the reduction of polyphenols. With regard to the various food preparations made with frozen spinach, it was observed an important quantity similar to that found in fresh vegetables. However, in the cooked sample the level of reduction was almost 50%. Vegetables that showed quantitative levels very similar to each other, despite being branded and backgrounds, were beets (data not listed), whereas artichokes were absolutely the richest foods in polyphenols. The determination of antioxidant activity showed unexpected results because the values associated with the anti-radical power (ARP) have highlighted the reduced activity of the foods analyzed, in some cases less than 0.1. Nevertheless, it can be seen that the products obtained with fresh vegetables have maintained a value of ARP generally higher than frozen products, although less than 1. As expected, the highest content of vitamin A was found in carrot samples (including fresh soups, presumably containing a significant quantity of carrots) , while the highest content of vitamin C was found in spinach and cauliflower samples. Unlike spinach, cauliflower appeared to maintain its vitamin content after boiling. The analysis of niacin pointed out that only soup samples, both fresh and frozen, showed values significantly higher than 1 mg/mg. Meat and fish samples turn out to be the most critical from the nutritional point of view. They had in fact a lipid content significantly higher than those of the fresh product. In most cases, the lipid content was significantly higher (+ 185%) when compared with reference values defined by the National Research Institute for Food and Nutrition (CREA) (see Table 2). Being saturated fats this can determine - in elderly adults that will consume - a worsening of cardiovascular diseases. A similar argument can be made for fish-based products. In fact, among the samples taken from the different nursing homes, the most frequent were foods to be breaded and thus more energy-rich. The use of Pangasius such as fish to be delivered is outstanding, since this product, while being generally low in fat content, it is a low-quality food (Marques Guimarães et al. 2015). Moreover, the general lipidic quality was evaluated with respect to the oxidation state and in this case it was found that the p-anisidine value (AV) was under the value of 5 in only 20% of the samples (generally, fat based products with an anisidine value below 5 were considered as good quality). To assess the oil quality were analyzed three parameters: the number of peroxides, the acidity and the anisidine index (see Table 3).

Table 1. Evaluation of the quality of vegetables. Total polyphenol content: values are average of three replicates. (RSD < 4%). ARP: values are average of three replicates. (RSD < 4%). Vitamins: values are average of three replicates. (RSD < 2%). nd=non detectable.

Vegetable sample		Total polyphenol content (µg/g)	Total polyphenol content per serving	ARP	Vitamin A mg/100g	Vitamin C mg/100g	Niacin mg/100g
V1	Canned peas	3.25	325	0.144	0.42	0.53	0.41
V2	Canned beans	3.15	315	0.0730	nd	1.3	nd
V3	Canned lentils	3.44	344	0.203	nd	0.47	nd
V4	Boiled carrots (frozen product)	4.31	647	0.0760	0.37	0.16	0.14
V5	Frozen carrots (sliced into rounds)	2.32	348	0.114	0.22	1.7	0.31
V6	Frozen baby carrots	1.51	227	0.566	0.83	3.2	0.43
V7	Frozen carrots (sliced into rounds)	2.36	354	nd	0.84	3.8	0.39
V8	Frozen vegetables soup	1.57	393	nd	0.49	3.3	3.9
V9	Frozen vegetables soup	2.02	504	0.0800	0.36	2.2	2.1
V10	Frozen vegetables soup	4.21	632	nd	0.40	2.5	1.5
V11	Frozen green beans	3.40	510	0.0740	0.022	6.3	0.11
V12	Frozen green beans	2.57	514	0,131	0.022	6.0	0.23
V13	Frozen peas	3.55	355	0.0760	0.051	12	0.85
V14	Frozen peas	2.56	256	0.915	0.042	19	1.1
V15	Frozen spinach	4.13	826	nd	0.42	18	0.43
V16	Frozen diced spinach	6.22	1.24×10^3	0.0540	0.46	42	0.38
V17	Boiled artichokes (frozen oproduct)	25.4	5.08×10^3	0.0106	0.050	18	nd
V18	Boiled spinach (frozen product)	3.46	692	nd	nd	nd	nd
V19	Boiled spinach (frozen product)	3.59	718	0.0750	0.33	nd	nd

V20	Frozen spinach	7.17	1.43×10^3	nd	0.33	21	0.42
V21	Frozen beans	4.53	544	0.151	0.0012	2.3	1.9
V22	Boiled cauliflower (frozen product)	1.41	254	nd	0.028	36	0.64
V23	Frozen cauliflower	2.56	512	0.449	0.038	45	0.95
V24	Frozen cauliflower	1.52	304	0.249	0.042	42	0.78
V25	Mix frozen vegetables	3.41	682	nd	0.47	17	1.2
V26	Fresh soup	12.3	2.46×10^3	nd	0.74	4.9	6.3
V27	Fresh soup	0.875	219	0.349	0.87	6.1	5.8
V28	Boiled fresh vegetables	3.20	640	0.111	0.23	9.4	1.5

Table 2. Evaluation of the quality of meat and fish-based products. INRAN =reference values for lipid content (%), by the National Institute for Research on Food and Nutrition (CREA). Lipid content: values are average of three replicates. (RSD < 4%). P-anisidine value: values are average of three replicates. (RSD <9 %).

Frozen meat/fish sample		Lipid content	INRAN	P-Anisidine Value
M1	Minced beef/pork	45,50	-	10,8
M2	Minced beef	15.12	14.02	1.44
M3	Hamburger	40.07	14.02	7.80
M4	Beef hamburger	49.90	14.02	7.58
M5	Minced beef	51.30	14.02	5.41
M6	Würstel	25.49	17.2	9.47
M7	Würstel	22.41	17.2	5.36
M8	Chicken breast	3.070	6.63	0.310
M9	Breaded chicken breast	20.75	20.74	9.57
M10	Chicken nuggets	22.10	18.04	14.3
M11	Meat balls (beef and soy)	7.630	-	5.18
F1	Fish fingers	10.24	7.62	6.19
F2	Pangasius fillets	4.030	3.0	2.16
F3	Breaded plaice fillets	11.42	7.62	7.99
F4	Cod fingers	13.27	7,62	7.72

Table 3. Evaluation of the quality of oil samples. Acidity: values are average of three replicates. (RSD < 2%). Peroxide value: values are average of three replicates. (RSD <5 %). P-anisidine value: values are average of six replicates. (RSD <7%).

Oil sample		Acidity (%)	Peroxide Value (mEq/kg)	P-Anisidine Value
O1	Extra virgin oil	0.323	8.84	10.6
O2	Olive oil (monoportion)	0.415	17.1	7.86
O3	Peanut oil	1.11	2.50	7.20
O4	Sunflower oil	1.13	4.82	12.1
O5	Olive oil	0.204	5.32	3.42
O6	Extra virgin oil	0.825	9.92	9.15
O7	Sunflower oil	1.16	4.97	8.72
O8	Extra virgin oil	0.384	10.5	7.84
O9	Peanut oil after frying	1.15	6.39	28.4

As far as olive oils are concerned, an oil to be classified extra virgin, must have an acidity value ≤ 0.8 while the value must be less than 2 for olive oil. As for the number of peroxides, the value must be ≤ 20 mEq. A good extra virgin olive oil should have a value of less than 6. All samples analyzed have been shown to belong to their class definition, in some cases, however, the peroxide value was significant although falling within the limits prescribed by law. Compared to the AV, however, it was observed, as in effect the secondary oxidation state was quite high, greater than 10 in more than 30% of the samples. Note the oxidation state of the oil used to fry (AV = 28.379).

FUTURE RESEARCH DIRECTIONS

The results of this preliminary study could represent an important first step for the implementation of a new food procurement policy, establishing more stringent requirements. Anyway, this study calls for further research, first to identify other parameters of food quality, such as, for example, macronutrient content, and then to correlate obtained data with clinical parameters, nutritional status indices, for example the Geriatric Risk Nutritional Index (GRNI) and the Mini Nutritional Assessment (MNA).

CONCLUSION

The greatest reductions of polyphenols content was found in cut vegetables, for reasons above described. In other vegetables the reduction was however significant, with the exception of broccoli, peas and spinach which show an increase compared to standard. Nevertheless, it must be considered that in industries these vegetables are submitted to blenching before freezing and that this process inactivates the polyphenoloxidases and fosters polyphenols release. Comparisons with similar commercial products showed for peas a level of quality similar to the sampled foods. Almost all vegetables showed a decrease of the total anti-oxidant capacity if compared with similar vegetables. The greatest loss was found in carrots, beets, broccoli and soups. The high content of polyphenols in beets, broccoli and pees suggests that, more than blenching, the presence of interfering elements like uric acid or xanthines is the real cause for the overestimation of the Folin-Ciocalteau test. Indeed, these molecules positively react to Folin-Ciocalteau test but do not show anti-oxidant activity. The conclusion is that in the case of broccoli, beets and pees, too, matrices were not best quality. Spinach, instead, demonstrated good levels of total anti-oxidant activity. The amount of polyphenols, per person, potentially ingestible with meals, hardly reached 150 - 200 mg/day, a very low quantity compared to recommended daily intake (for an example concerning older people, see Zamora-Ros et al. 2013). Also, the vitamin content was significantly lower – except in sample V16 (see Table 1) with respect to reference nutritional values established by INRAN for corresponding products (CREA). Finally, the high values of p-anisidine found in this study mean that the analyzed food, in addition to being particularly energetic, determines the introduction in the organism of significant quantities of secondary oxidation products. Certainly the quality of most products used in these residences (data analysis does not prove substantial differences between products used in public homes compared to private ones). is significantly lower, compared to fresh and/or commercial products targeting "normal" consumers. Consequently, the authors believe that this kind of diet is inadequate for elderly nutrition, since it is lacking those nutritive principles that are necessary to the body protection, rather than to the energy requirements.

REFERENCES

Bellini, G. Manuale di buone prassi per la qualità del servizio nelle Strutture Residenziali per Anziani. Presented at Congress UNEBA, Trieste 14th October 2009.

CREA. Council for Agricultural Research and Economics, Research Center for Food and Nutrition. Tables of food composition [in Italian]. http://nut.entecra.it/646/tabelle_di_composizione_degli_alimenti.html.EU. Commission implementing regulation (EU) No 299/2013 of 26 March 2013 amending Regulation (EEC) No 2568/91 on the characteristics of olive oil and olive-residue oil and on the relevant methods of analysis *Official Journal of the European Union.*

ISTAT. Forecasts 2011-2065 . Based on pre-census data. Demographic Indicators [in Italian]. dati.istat.it.

Laguerre, L., Lecomte, J., Villeneuve, P. 2007. Evaluat ion of the ability of antioxidant to counteract lipid oxidation: Existing methods, new trends and challenges. *Progress in Lipid Research* 46: 244-282.

Lo, Y.T., Chang, Y.H, Wahlqvist, M.L., Huang, H.B., Lee, M.S. 2012. Spending on vegetable and fruit consumption could reduce all-cause mortality among older adults. *Nutrition Journal* 11:113-121.

Lombardo, S. 2009. *Residenze per gli anziani. Guida alla progettazione*. 3rd Edition, Dario Flaccovio Publisher, Palermo (Italy).

Marques Guimarães, C.F., Teixeira Mársico, E.,Guerra Monteiro,M.L., Lemos, M., Borges Mano, S., Adam Conte Jr., C. 2015. The chemical quality of frozen Vietnamese Pangasius hypophthalmus fillets. *Food Science & Nutrition.* Article first published online 26 October 2015. http://onlinelibrary.wiley.com/ doi/10.1002/fsn3.302/pdf.

Ministry of Health. National Guidelines for hospital and health -care food service [in Italian] Official Journal of Italian Republic no 37, February 15th, 2011.

Official Pharmacopoeia of the Italian Republic XII edition in force since 31/03/2009 [in Italian]. Rome: Polygraphic Institute of the State 2008.

Re, R., Pellegrini, N., Proteggente, A., Pannala, A., Yang, M., Rice-Evans C. 1999. *Free Radical Biology & Medicine*. 26:1231-1237.

Singleton, V.L., Orthofer, R., Lamuela-Raventós, R.M. 1999. Analysis of total phenols and other oxidation substrates and antioxidants by means of folin-ciocalteu reagent *Methods in Enzymology* 299: 152-178.

World Health Organization. Nutrition for older persons. www.who.int/nutrition/topics/ageing/en/.

Zamora-Ros, R., Rabassa, M., Cherubini, A., Urpí-Sardà, M., Bandinelli, S., Ferrucci, L. and Andres-Lacueva, C. 2013. High Concentrations of a Urinary Biomarker of Polyphenol Intake Are Associated with Decreased Mortality in Older Adults. *The Journal of Nutrition* 143: 1445-1450.

Zangara, A., Bianchi, E. 1991. *Dietologia*. 2nd Edition, Piccin Nuova Libraria S.p.A., Padova (Italy).