

AN EVALUATION OF THE MECHANICAL AND SENSORY CHARACTERISTICS OF SELECTED FOODSTUFFS FOR SENIOR CITIZENS

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ABSTRACT

Background. The population of Poland is one of the fastest ageing communities in Europe. Due to people's ageing it is necessary to adapt the daily diet to these consumers' requirements. The potential producers of food for senior citizens must allow for elderly people's possibilities to consume meals (the structural aspect) and their nutritional needs. The aim of the study was to perform an instrumental analysis of the mechanical properties and sensory evaluation of selected foodstuffs for senior citizens.

Materials and methods. The foodstuffs were purchased in Japan. There were three meat and vegetable stew products and two creamy soup products. The texture of the samples was analysed at temperatures of about 22°C and 55°C by means of a shear test or with a penetrometer. Dynamic mechanical thermal analysis was applied to characterise the rheological traits of the samples heated to temperatures of 22–55°C. The finished products were evaluated by a ten-member panel trained in accordance with the requirements of PN-EN ISO 8586: 2014-03.

Results. The values of the texture parameters of all the samples were low and they were even more significantly reduced when the products were heated. The dynamic viscosity of the systems showed their relatively high density. Among the meat and vegetable dishes, dish no. 2, i.e. beef with vegetables, had the highest score in consumer preferences, i.e. 91.1%. Among the cream soups, sample no. 5, i.e. chicken & vegetable, had the highest score, i.e. 83.8%. The evaluation panel noted that the products were not sufficiently flavoured.

Conclusions. The results of the instrumental and sensory tests showed that the products for senior citizens had desirable structural characteristics, which are important for their consumption. As the issue of food for senior citizens is important for consumers all over Europe, it is necessary to consider the taste preferences of consumers inhabiting a particular geographical region (traditional flavours) before such foodstuffs are offered on the market.

Keywords: food for seniors, rheology, texture, sensory evaluation

INTRODUCTION

Ageing is a natural and inevitable phenomenon that affects people all over the world. In recent decades, the intensity of this phenomenon has increased significantly, especially in developed countries. The ageing of society is a long-term tendency which began in

Europe several decades ago. As of 1st January 2017, the estimated population of the European Union was 511.5 million. Young people (aged 0–14 years) made up 15.6% of the EU-28 population, whereas people at the working age (15–64 years) made up 64.9% of the

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population. The percentage of elderly people (aged 65 years or more) was 19.4% (an increase of 0.2 percent as compared with the previous year and an increase of 2.4 percent as compared with the previous 10 years). It is estimated that by 2080, the percentage of people aged 65 or more will have increased to 29.1% of the total EU population, as compared with 19.4% in 2017 (EUROSTAT Statistics Explained – ec.europa.eu).

The increase in the relative share of elderly people can be attributed to extended life expectancy. In addition, for many years there have been low fertility rates, which have contributed to the ageing of the population. Another aspect of ageing is the progressive ageing of the older part of the population, because the relative number of very old people is growing faster than any other age segment of the EU population. It is estimated that between 2017 and 2080, the share of people aged 80 years or more in the total EU-28 population will have increased to more than twice the current amount, i.e. from 5.5% to 12.7% (EUROSTAT Statistics Explained – ec.europa.eu).

The population of Poland is one of the fastest ageing communities in Europe. The increase in the number of senior citizens will be accompanied by a significant decrease in the number of people aged 15–64 years. According to the estimates of the Central Statistical Office, in 2025 there will be over 10 million people aged over sixty in Poland, i.e. almost 28% of the population. In 2035 there will be 11.4 million people in this age group (32%), whereas in 2050 there will be more than 13.7 million (40%) (GUS, 2019).

Due to people's ageing, it is necessary to adapt the daily diet to these consumers' requirements. The potential producers of food for senior citizens must allow for elderly people's possibilities to consume meals (the structural aspect) and their nutritional needs. Elderly people often suffer from taste and smell disorders, which cause them to feel no hunger and lose appetite. Dental and gingival diseases are a very common problem, which significantly reduces these consumers' ability to chew and crush food. In consequence, their ability to swallow is significantly impaired, which affects their health and quality of life (Smith et al., 2009; 2014). At older ages, the secretion of saliva is reduced and there are lesions in the mucous membranes of the intestines and stomach, which impair the absorption of various nutrients. Another problem is slower intestinal

peristalsis, which causes the retention of faecal masses and persistent constipation. The poorer secretion of bile and pancreatic juice causes digestive disorders.

Dysphagia always signals an underlying disease or difficulty which may be caused by neurological, surgical, mechanical or psychological disorders (East-erling and Robbins, 2008). Many swallowing disorders have a neurological background and are associated with diseases such as stroke, Parkinson's disease, Alzheimer's disease, dementia and throat cancer. Food with a modified structure may facilitate safe consumption (Ekberg et al., 2002; Rothenberg et al., 2007). However, for therapeutic success, everyone involved in the treatment of senior citizens must use the same terminology and recommend a diet with a modified texture. Penman and Thomas (2008) found considerable diversity in the definitions of the modified texture of this food. There were 2–5 categories of modified solid food and 1–6 categories of liquids in descriptions of this diet. Series of graded consistency are the most common diets. These are liquidised/thin puree, thick puree/soft and smooth, soft/finely minced and minced/normal. However, none of the definitions of these diets is based on objective measurements. The effectiveness of dysphagia therapies depends on recommended viscosity (thickness) (Wendin et al., 2010).

Rheology is the scientific study of the deformation and flow of materials. It describes the properties of various materials, both liquids (viscous) and solids (elastic). However, almost all materials, especially food products, exhibit both viscous and elastic properties. Due to their rheological behaviour, they are placed between liquids and solids and defined as viscoelastic materials (Mezger, 2006). Such rheological properties may affect pharyngeal swallowing as they influence bolus transport (Meng et al., 2005). Taking objective measurements of thickened liquid flow is a complex task. Many researchers have stressed the need to provide precise definitions and make objective measurements regarding the preparation of a texture-modified diet, the serving temperature, and the stability of food viscosity over time (Adeleye and Rachal, 2007; Budke et al., 2008; Dewar and Joyce, 2006; Garcia et al., 2005; 2008; Germain et al., 2006; Mark and Robbins, 2007). Rheological measurements analyse the physical properties of food samples, whereas sensory analysis is used to evaluate texture attributes

perceived by the human senses. A trained analytical sensory panel can make objective descriptions of perceived sensory attributes and thus discover quantitative differences between food products (Lawless and Heymann, 1998).

It is noteworthy that senior citizens want to stay active and enjoy their free time. Contrary to stereotypes, these people often have good and stable incomes, and they are not burdened with the expenses of starting a family or educating children. Elderly people are a group of consumers with very specific requirements. Food manufacturers are trying to face this challenge, but the vast majority of them are only observing this trend. Due to the constant increase in the number of senior citizens, food producers will have to expand the range of products aimed at this group of consumers.

In view of the abovementioned information, and due to the fact that it is a pan-European problem, we conducted preliminary research to perform an instrumental analysis of the mechanical (rheological and texture) properties and sensory evaluation of selected products available on the Japanese market of foods for senior citizens. The analysis of these characteristics will enable potential food producers to identify the recommended physical parameters of ready-to-eat food products for elderly people. There is a wide range of these products in Japan because for many years this country has been struggling with a low birth rate. In view of the fact that there is a high percentage of old people in Japan, food producers have developed and introduced products specifically labelled for this group of consumers. The analysis of global implementations of new products on the market shows that as many as 8 out of 10 products with the information on the packaging aimed at older people are released on the Japanese and Chinese markets.

MATERIALS AND METHODS

Research samples

Products purchased in a Japanese chain store were used as the research material. Five ready-to-eat products, which could be served hot or cold, were tested. The samples were numbered 1 to 5.

Sample no. 1. Japanese hamburger steak (Asahi Balance Kondate) for senior citizens who are able to

grind food with their gums. The product is a delicate burger in sauce with vegetables. The burger was made from chicken and pork, carrots, potatoes and onions. Produced by Asahi Group Food Co., Ltd., Japan, package weight: 100 g.

Sample no. 2. Beef with vegetables – easily digestible stew with pieces of beef, potatoes, onions and carrots which is aimed at senior citizens. Produced by Maruha Nichro Co., Japan, package weight: 100 g.

Sample no. 3. Creamed chicken for senior citizens who are able to grind food with their gums. The product is chicken stew in white sauce with cheddar cheese, potatoes, noodles and carrots. Produced by Asahi Group Food Co., Ltd., Japan, package weight: 100 g.

Sample no. 4. Creamed pork & vegetable. A soup made from pork cooked for a long time and from potatoes, onions, soy, and ginger, which have been shredded so as to make a smooth cream. The product is enriched with calcium and aimed at senior citizens who find it hard to grind food. Produced by Maruha Nichro Co., Japan, package weight: 75 g.

Sample no. 5. Creamed chicken & vegetable. A soup made from chicken cooked for a long time and from potatoes, onions, celery, and soy, which have been shredded so as to make a smooth cream. The product is enriched with calcium and aimed at senior citizens who find it hard to bite food. Produced by Maruha Nichro Co., Japan, package weight: 75 g.

Sample preparation

Before the assessment of rheological properties, texture and sensory evaluation, the samples were heated in a 500 W microwave oven for 20 or 30 seconds, according to the instructions on the package. Before heating, the product was unpacked and placed in a 100 ml plastic container. The temperature of the heated product was about 55°C. Additionally, the samples were also analysed at room temperature (around 22°C) to compare the influence of temperature on texture characteristics.

Texture analysis

The texture was analysed by means of a TA-XT2i Texture Analyser (Surrey, England). Solid elements, such as meat and vegetables, were removed from samples 1–3. They were adjusted to cubes of about 6x6x6mm. Next, they were subjected to a shear test to determine

the maximum shear force value, g. Due to the homogeneity of samples no. 4–5, their texture was assessed by means of a penetration test. The following parameters were assessed: firmness, g, consistency, g, cohesiveness, g, and index of viscosity, g·s. The samples were penetrated to a depth of 40% of their initial height with a cylindrical pin with a diameter of 35 mm. The settings of the texture analyser were as follows: test speed 1.0 mm/s; trigger force 5 g; PPS 200.

Rheological properties

A dynamic mechanical rheological analyser DMWT (COBRABiD – Poznań, Poland) was used for measurements. The viscoelastic properties of systems examined in rheometers operating on the principle of the free vibrations technique (dynamic mechanical analysis – DMA), are calculated by analysing the parameters of the curve of the free pendulum and damped vibrations with and without the sample (vibration frequency and damping decrement) (Rezler and Poliszko, 2010). A cone-plate measuring system was applied (cone diameter 30 mm, angle 6°). The following components of the complex modulus of elasticity were calculated: elasticity modulus (G'), loss tangent ($\tan \delta$) and dynamic viscosity (h). The elasticity modulus is associated with the part of potential deformation energy maintained in the course of periodical deformations. The loss tangent ($\tan \delta$) is a measure of internal friction. It describes the relative quantity of energy dissipated in the material in the course of one deformation cycle. The frequency of vibrations within the systems was 1.2 Hz. The mechanical and rheological properties of the systems were tested at a temperature of about 24°C. The temperature of the chamber and measurement plate was measured with an accuracy of $\pm 0.2^\circ\text{C}$. The linear viscoelastic region of each sample was taken into account.

Sensory analysis

The finished products were evaluated by a ten-member panel trained in accordance with the requirements of PN-EN ISO 8586: 2014-03. The scaling method (PN-ISO 4121:1998) was used to quantify the intensity of a selected product trait by means of a pre-agreed scale. The products were evaluated by ten well-trained and experienced workers from the Sokołów S.A. Branch, Sokołów Podlaski, Poland (average age 40 years).

The following sensory characteristics of the finished products were evaluated: the appearance of the hot and cold product, the colour of the hot and cold product, the proportions of ingredients, the odour of the hot and cold product, and the taste and consistency of the hot product. The individual sensory characteristics were evaluated by means of a five-point scale with the following grades of intensity: very attractive, distinctive, standard (5 points), attractive, with small deviations (4 points), average, with noticeable deviations (3 points), unsuitable, with significant deviations (2 points), unacceptable (1 point).

Consumers' preferences concerning general product acceptability were also rated according to the following scale:

I love it	8 points
I like it very much	7 points
I quite like it	6 points
I like it only a little	5 points
I neither like nor dislike it	4 points
I slightly dislike it	3 points
I rather dislike it	2 points
I totally dislike it	1 point

The aim of the sensory test was to internally evaluate possible consumer preferences, and an 8-point scale was used instead of a typical hedonic scale. It was performed by a team of ten people aged 65–75 (4 males and 6 females) using a scaling method.

Statistical analysis

The rheological and textural analyses of hot and cold products were replicated six times. The sensory analysis was replicated five times. The significance of the results (LSD test) at $p < 0.05$ was tested by means of a one-way ANOVA. All the results were analysed statistically with the SPSS software ver. 13.0 (SPSS Inc., USA).

RESULTS AND DISCUSSION

Texture measurements

Studies on old people's diseases and related nutritional problems have shown that the food consumption in this group of consumers could be increased by providing food with a modified texture (Germain et al., 2006; Rothenberg et al., 2007). Therefore, people

with swallowing disorders are recommended to consume concentrated fluids. Thus, the risk of aspiration is reduced because condensed fluids have a higher viscosity and a lower flow rate. This is important for safe swallowing (Cho and Yoo, 2015; Taniguchi et al., 2008).

The texture of food is a complex concept which can be described both in a physical and sensory sense. In the physical sense, it is a rheological property of products. It comprises the relations between stress, strain and time.

Cutting force of solid soup particles. The texture of foodstuffs containing pieces of meat or vegetables must be sufficiently soft for senior citizens with grinding and swallowing problems to eat them. The first three product samples were in the form of stew with small pieces of vegetables and meat. The cutting force of these elements had very low values. The vegetable ingredients could be ground with the tongue or gums only. On average, the maximum cutting force of the vegetable pieces amounted to 150 ± 26 g at a temperature of about 22°C ($p < 0.05$) (Table 1). The average cutting force of the minced meat pieces (sample no. 1 – hamburger) amounted to about 387 ± 25 g ($p < 0.05$), whereas the cutting force of the chicken

pieces (sample no. 3) was $1,208 \pm 98$ g ($p < 0.05$). Sample no. 2 contained beef pieces, but they were so small that it was impossible to assess their hardness in the shear test.

Heating significantly affected the texture parameters of the samples. When the product temperature increased to about 55°C , the cutting force of the vegetable pieces was significantly reduced, i.e. by about 30 percent (p.p.). As far as the meat elements are concerned, i.e. hamburger and chicken, the cutting force increased respectively by 26 p.p. and 17 p.p. when the samples were heated. The meat pieces with a preserved structure of chicken muscle fibres were slightly harder (sample no. 3). The comminution of meat significantly reduces its hardness. This information is important, and it should be taken into account in research on the production of food for senior citizens.

Penetration test. Samples no. 4 and 5 were different products than samples no. 1–3 described above. The producer prepared them in the form of homogeneous creams containing vegetable and meat ingredients. The texture parameters of the products indicate their low hardness as well as their relatively high density and viscosity. This fact was confirmed by the values of consistency and index of viscosity (Table 2).

Table 1. The maximum cutting force of meat and vegetable particles in samples no. 1–3, g

Type of sample	Ingredient	Temperature, °C	
		22	55
Hamburger steak (sample no. 1)	hamburger	$387.3 \pm 25.8a$	$285.7 \pm 19.8b$
	carrot	$131.9 \pm 10.2a$	$112.5 \pm 9.8b$
	potato	$128.3 \pm 10.1a$	$62.6 \pm 4.7b$
Beef with vegetables (sample no. 2)	carrot	$175.3 \pm 12.2a$	$156.5 \pm 12.3b$
	potato	$193.6 \pm 13.4a$	$93.5 \pm 7.5b$
Creamed chicken (sample no. 3)	meat	$1\ 207.8 \pm 98.9a$	$1\ 006.1 \pm 89.8b$
	potato	$127.6 \pm 11.0a$	$92.2 \pm 7.9b$
	carrot	$141.2 \pm 10.7a$	$110.3 \pm 8.5b$
	pasta	$169.5 \pm 14.5a$	$93.0 \pm 7.6b$

a, b – different letters in the same row indicate statistically significant differences between mean values at $P < 0.05$; \pm SD ($n = 6$).

Table 2. The mean values of the texture parameters of homogeneous products (samples no. 4 and 5)

Type of dish	Temperature, °C	Firmness, g	Consistency, g·s	Cohesiveness, g	Index of viscosity, g·s
Creamed pork & vegetable (sample no. 4)	22	120.6 ±10.0a	1 782.7 ±131.1a	27.8 ±2.1a	1 124.9 ±109.5a
	55	90.1 ±8.2b	1 507.3 ±125.3b	18.9 ±1.5b	785.2 ±56.8b
Creamed chicken & vegetable (sample no. 5)	22	120.3 ±10.3a	1 803.9 ±141.2a	29.9 ±1.9a	1 151.9 ±112.1a
	55	83.5 ±6.5b	1 463.7 ±121.4b	20.9 ±1.6b	667.5 ±58.4b

a, b – different letters in the same row indicate statistically significant differences between mean values at $P < 0.05$ ($n = 6$).

As was the case with the samples described above, the heating process significantly reduced all texture parameters, especially firmness, cohesiveness and index of viscosity, which dropped by about 28 p.p., 31 p.p. and 36 p.p., respectively. It seems that, from the consumers' point of view, firmness and cohesiveness, which characterise the strength of internal bonds in the structure of the sample, and the index of viscosity are important parameters. Their values were small, so potential consumers should not have problems with the consumption of these products.

Rheological analysis

Each product has its own rheological characteristics – solids become deformed, whereas liquids flow. During rheological tests, samples become less deformed than during the preparation for consumption and when they are being consumed. Thus, rheological measurements may only approximate actual sensory feelings which signalise the rheological, structural, geometric and surface properties of food which humans perceive with their senses. Although there have been numerous attempts to quantitatively determine the sensory properties of foods on the basis of physical measurements and chemical characteristics of these products (van Vliet, 2002), the results have not been fully satisfactory. Researchers are increasingly convinced that the structure and rheological behaviour of products may be strongly influenced by the conditions in the consumer's mouth when they are digested (de Wijk et al., 2003). In general, thickeners containing modified starches are commonly used in a wide range of commercially available processed products. Due to the convenience of their preparation for consumption and low costs, these products are extremely popular,

especially among elderly people (Garcia et al., 2005). Also, all products tested in this research contained thickeners in the form of xanthan gum and modified starch. In contrast to commonly used modified starches, soups thickened with gums have a smoother texture, and much better taste and odour.

Samples no. 4 and 5 in the form of homogeneous creams were also tested. Apart from that, an instant red beet soup without thickeners or solid fragments, purchased in a chain store, was analysed rheologically. The measurements of dynamic viscosity η (Fig. 1) of samples no. 4 and 5 showed that they were characterised by a relatively high density and consequently, by a high viscosity. The value of this parameter was significantly reduced by heating. Soup no. 6 was characterised by significantly lower values of dynamic

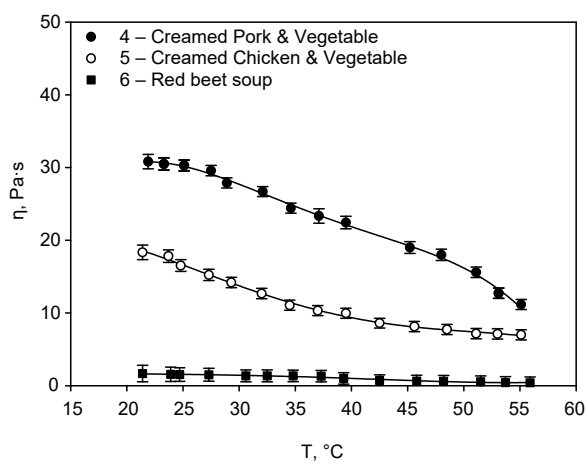


Fig. 1. Variations in the dynamic viscosity (η) of the research samples during heating ($P < 0.05$, $n = 6$)

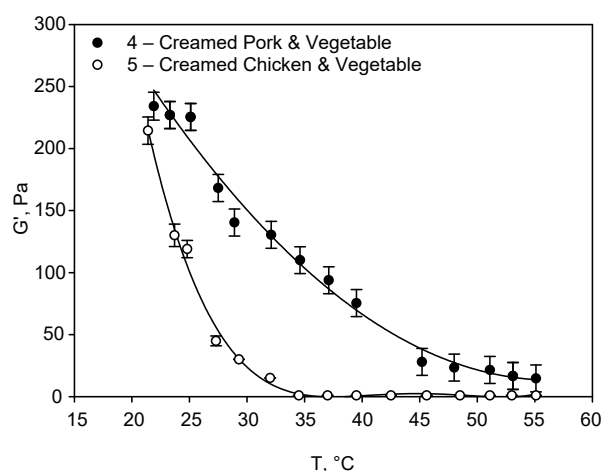


Fig. 2. Variations in the modulus of elasticity (G') during the heating of the test samples ($P < 0.05$, $n = 6$)

viscosity than soup no. 4 within the whole range of temperatures analysed. At the same time, there were minimal changes in the viscosity of the red beet soup. This observation confirmed the fact that the addition of starch and gum to soups increased their elastic properties.

This is important because elderly people, who often have swallowing problems, find thickened liquids easier to eat and creamier than low viscosity soups. According to sensory and rheological research, creaminess may be related to viscosity (Wendin et al., 1997).

Soups are usually served hot. From the physicochemical point of view, the soups analysed in our experiment were systems with the properties of semi-liquid bodies. Additionally, due to the content of a large number of ingredients, during thermal treatment, individual components undergo phase transitions and changes in the state of matter. This fact was confirmed by the analysis of variations in the modulus of elasticity G' and loss tangent $\text{tg } \delta$ measured during the heating of the test samples (Fig. 2 and 3).

The modulus of elasticity G' , determined during the measurements, is a measure of the stiffness of the tested systems, which reflects their density, rather than a measure of their elastic properties. This is related with the consistency of the tested system. The temperature-dependent variations in the modulus of elasticity indicated that soup no. 5 reached the liquid state at lower temperatures than soup no. 4. On the other

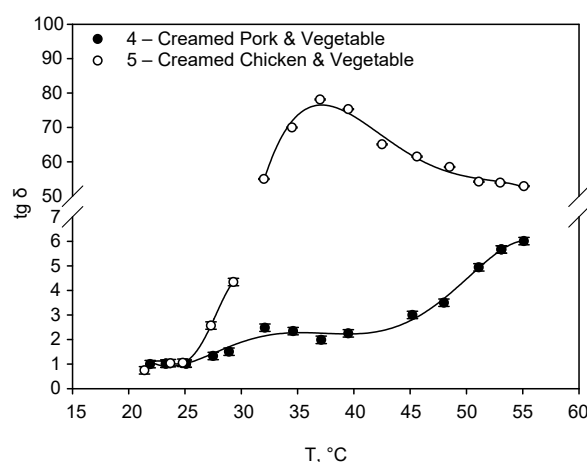


Fig. 3. Variations in the loss tangent ($\text{tg } \delta$) during the heating of the test samples ($P < 0.05$; $n = 6$)

hand, the temperature-dependent variations in the loss tangent $\text{tg } \delta$ (Fig. 3) showed that from a rheological point of view, the soup systems could be classified as non-Newtonian liquids from the group of pseudoplastic fluids. Apart from that, the analysis of variations in the dynamic viscosity at a higher shearing rate showed that the value of this parameter decreased. This fact proved that the soups were non-Newtonian systems thinned by shearing.

Some differences in the rheological traits and texture parameters may result from the raw materials and the degree of their comminution. Due to the considerable homogenisation of meat and vegetables, samples no. 4 and 5 were perceived as softer and smoother. These qualities of texture are characteristic of products classified as timbale, which are distinguished by a soft, smooth, fine and consistent texture, similar to that of an omelette. Undoubtedly, this structure may facilitate chewing and crushing in the oral cavity and thus, such products are safe to swallow (Wendin et al., 2010). On the other hand, lesser comminution of meat or vegetable ingredients in the finished product (samples no. 2 and 3), may cause consumers to perceive a greater granularity and roughness in these products, as compared with the abovementioned timbales. In consequence, it may result in a sensation of dryness in the mouth, which could make these foods difficult to crush and swallow for some people (Ilhamto et al., 2014).

People with dementia can have feeding and swallowing difficulties (dysphagia). Modification of the consistency of food or fluids, or both, is a common management strategy. However, diet modification can affect quality of life and may lead to dehydration and malnutrition. Evidence of the benefits and risks of modifying food and fluids is mandatory to improve the care of people with dementia and dysphagia. Flynn et al. (2018) determined the effectiveness and adverse effects associated with modifying the consistency of food and fluids in improving oral intake and eliminating aspiration in adults with dysphagia and dementia. The study compared the effects of nectar and honey thick liquids with a chin down head posture over a three-month period in a subgroup of 260 participants with dementia. Outcomes were pneumonia and adverse intervention effects. Honey thick liquids, which are more consistent with descriptors for ‘spoon thick’ or ‘extremely thick’ liquids, showed a more positive impact on immediate elimination of aspiration during videofluoroscopy. However, the authors suggested

that they are uncertain about the immediate and long-term effects of modifying the consistency of fluid for swallowing difficulties in dementia as too few studies have been completed.

Sensory evaluation

Figure 4 shows the photos of the finished meat and vegetable dishes (samples no. 1–3) and cream soups (samples no. 4–5) subjected to sensory evaluation. The products containing meat and vegetable pieces (samples no. 1–3; Fig. 5A) underwent a separate sensory evaluation from the creamy soups (samples no. 4–5; Fig. 5B). According to the evaluators, the taste of the sauce and meat in dish no. 1 was slightly too mild, whereas the taste of spices was poorly perceptible (60% of the evaluators). The amount of the vegetable stock cube in the sauce was insufficient (50% of the evaluators). The colour of the sauce in dish no. 2 was too light (50% of the evaluators). The pieces of meat in dish no. 3 were too large compared with the size of the vegetable stock cube (30% of the evaluators).

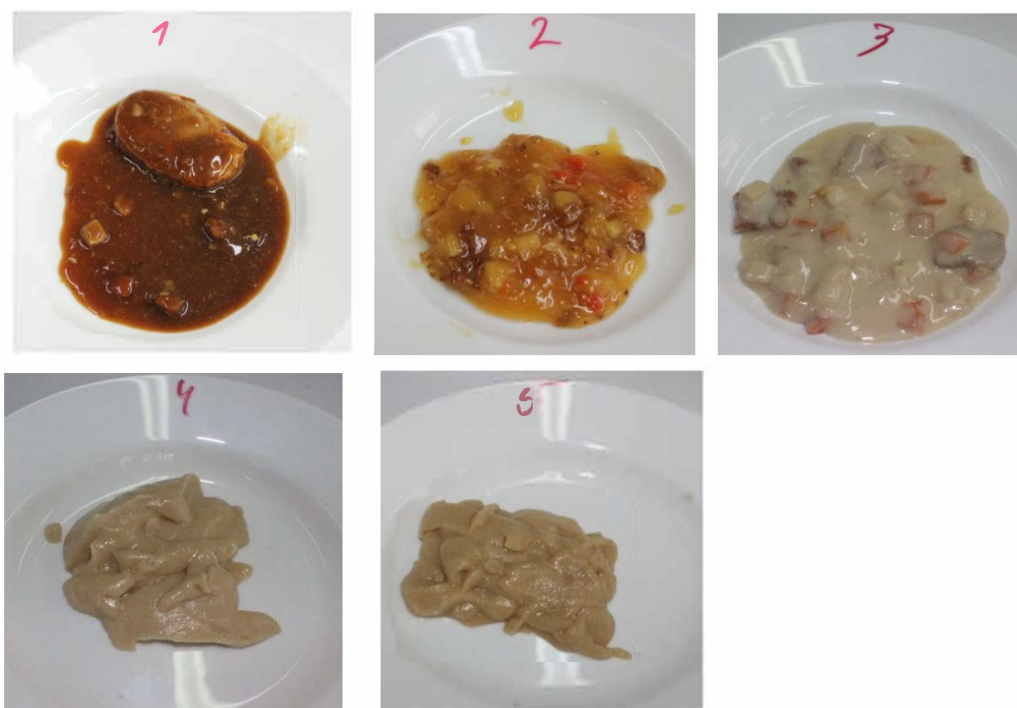


Fig. 4. Photos of the finished meat and vegetable dishes (samples no. 1–3) and cream soups (samples no. 4–5) subjected to sensory evaluation

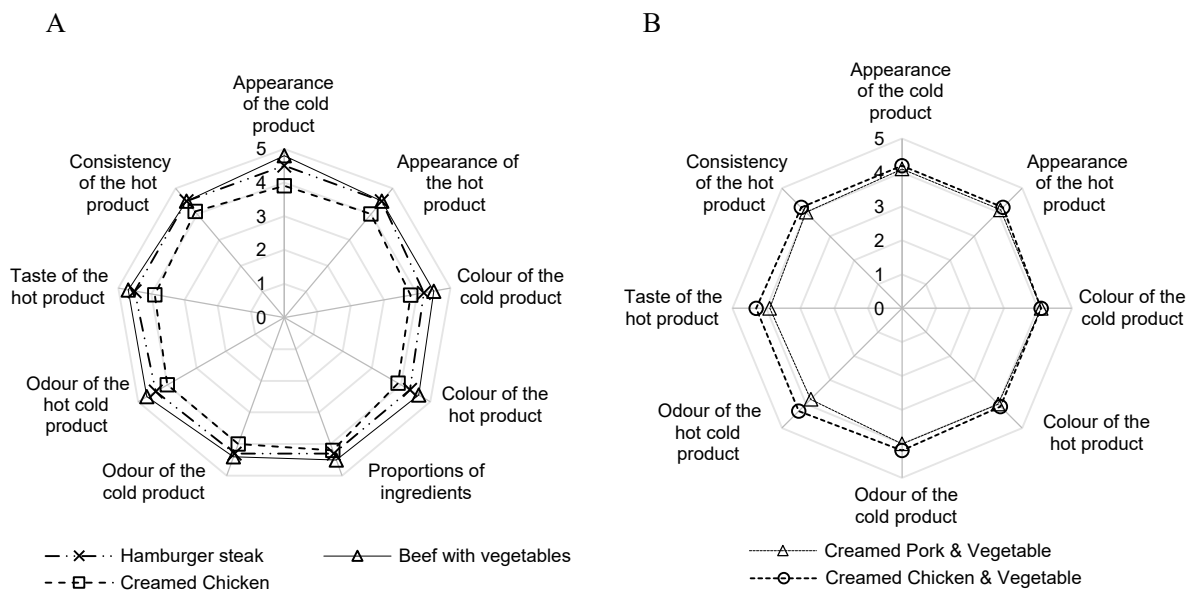


Fig. 5. A diagram of the intensity of sensory characteristics of the meat and vegetable dishes: A – samples no. 1–3, B – samples no. 4–5)

The analysis of consumers' preferences showed that dish no. 2, i.e. beef with vegetables, had the highest score (91.1%). It was followed by dish no. 1, i.e. the Japanese hamburger steak (87.5%) and dish no. 3, i.e. creamed chicken (77.9%). Figure 5B shows a diagram of the intensity of the sensory determinants of samples no. 4 and 5. According to the evaluation panel, sample no. 4 (creamed pork & vegetable) tasted slightly too floury (60% of the evaluators), whereas sample no. 5 (creamed chicken & vegetable) tasted slightly too gingery (30% of evaluators). The results of the analysis of consumers' preferences showed that soup no. 5 was rated higher (83.8%) than soup no. 4 (78.3%). As can be seen in Figure 4B, most of the sensory characteristics of sample no. 5 were rated higher than those of sample no. 4, no matter if the dishes were served hot or cold.

The sensory characteristics of the foodstuffs tested in our study were different from the products available on the Polish market. The evaluation panel noted that they were characterised by sensory vapidness, i.e. the lack of a distinctive taste profile, which could be achieved by using spices with adequately correlated levels of salt and fat. The level of fat in the products was relatively low – it ranged from 4.2% (sample no. 3)

to 7.4% (sample no. 5). Obviously, it is necessary to remember to properly balance the demand for energy in foodstuffs for elderly consumers. This involves the need to provide these consumers with adequate daily rations of selected nutrients in the meals they eat.

Penman and Thomas (2008) put across a model of progression diets for dysphagia by classifying and describing a food's texture. Food was categorized into four groups, each with its own predetermined texture:

1. Liquidized – thin puree. Homogenous consistency which does not hold its shape after serving.
2. Thick puree – soft and smooth. Thickened, homogenous consistency which holds its shape after serving, and does not separate into liquid and solid components during swallowing, i.e. cohesive.
3. Soft – finely minced. Soft diet of cohesive, consistent textures requiring some chewing.
4. Minced – normal. Normal foods of varied textures which require chewing, avoiding particulate foods which pose a choking hazard.

The researched cream type soups can be put into the second group, while the remaining three meat vegetable stew products can be placed into the “minced” category.

CONCLUSIONS

The instrumental and sensory tests done on the food products for senior citizens determined the values of qualitative characteristics of these foodstuffs which are important in terms of the possibility of their consumption. The textures of 5 products were characterised by combining sensory evaluation and mechanical measurements. The values of the texture parameters of all the samples were low and they were even more significantly reduced when the products were heated. This may suggest that the products should not be difficult to consume. The homogenous soups evaluated in the experiment were non-Newtonian systems of the group of pseudoplastic liquids thinned by shearing (their viscosity decreased as the shearing rate increased). The G' parameter, which was determined during the measurements, is a measure of the stiffness of the tested systems, which reflects their density, rather than a measure of their elastic properties. It is related with the consistency of the tested system. The hardness and cohesiveness, which reflect the strength of internal bonds in the product structure, as well as the viscosity of foodstuffs are important characteristics for consumers. The pieces of meat with a preserved structure of muscle fibres were slightly harder fragments. When designing dishes for senior citizens, it is necessary to take their optimal consistency into consideration. This effect can be achieved through the choice of an adequate production technology (e.g. the method of grinding, heat treatment), raw material and the water content in the end product. As the issue of food for senior citizens is important for consumers all over Europe, it is necessary to consider the taste preferences of consumers inhabiting a particular geographical region (traditional flavours) before such foodstuffs are offered on the market.

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