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The Quality of Salted Potato Chips Available on the Polish Market*

Abstract

Potato chips are a commonly known snack eaten by people of all ages. Due to the high fat and salt content, as well as acrylamide and trans fatty acids resulting from high temperature frying, they are considered to be unhealthy. Nevertheless, they have a desirable taste, often improved by the addition of monosodium glutamate, and are therefore frequently consumed.

On the Polish market there are many food companies that produce potato chips. It is therefore an important foodstuff on the market. However, prices and nutritional values can differ significantly. The aim of the study was to assess the quality of salted potato chips available on the Polish market. For this purpose, seven products offered by different producers were chosen. Samples were collected from four production batches, and the nutritional values and acid and peroxide values were analysed. Sensory quality, then number of damaged or structurally defective chips and the integrity of the packaging were examined. The results show that the nutrients and sensory quality of salted potato chips available on the Polish market differ significantly.

Keywords: snacks, potato chips, salted potato chips, quality of potato chips.

JEL Classification: Y80.

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1. Introduction

Modern food production technologies have brought about changes in the human diet. Because people have less time to prepare meals, more and more consumers are choosing foods that can be consumed “on the go” (Babicz-Zielińska, Jeżewska-Zychowicz & Laskowski 2010). Potato chips are a popular snack people of all ages consume (Salvador *et al.* 2009). However, due to their high fat and salt content, as well as the acrylamide (Zhang, Zhang & Zhang 2005), aldehydes, ketones and trans fatty acids (Moros *et al.* 2009) they contain as a result of the high temperature frying used to produce them, they are considered unhealthy (Yi *et al.* 2015). Acrylamide is associated with elevated cancer risk, neurotoxic effects, reproductive toxicity, genotoxicity, and mutagenicity (Medeiros-Vinci, Mestdagh & De Meulenaer 2011).

Nevertheless, due to their desirable taste, frequently enhanced by the addition of monosodium glutamate, potato chips are frequently consumed during social events. As a snack, they are also eaten during the day, especially by children (Allshouse, Frazao & Turpening 2002, Hassan & Al-Dosari 2008).

While many companies produce potato chips, the products differ significantly in terms of both price and nutritional value. Consumers are more aware of the food-nutrition-health relationship (Salvador *et al.* 2009). They are more informed about the quality of the products they consume (Arias-Mendez *et al.* 2013, Shiroma & Rodriguez-Saona 2009). Given people’s desire to be informed and the popularity of potato chips, this study was undertaken to assess the quality of salted potato chips available on the Polish market.

2. Material and Methods

The research was conducted on seven varieties of salted potato chips available on the Polish market and produced by different manufacturers. The samples were bought in supermarkets in Cracow. All of the samples came in their original and sealed packaging. The material comprised four production batches and was collected in 2015. The samples were coded with the letters A–G.

The research programme was prepared on the basis of Polish Standard PN-A-74780:1996 “Potato products. Fried potato snacks” and was divided into two stages.

The first stage of the study determined the chemical composition of the potato chips and calculated their energy value. It examined:

- peroxide value (PV) as determined by iodometric method to measure the iodine liberated from potassium iodide (KI) after reacting with the peroxides present in the samples (PN-A-74780:1996),
- acid value (AV) by neutralising the free fatty acids with potassium hydroxide (PN-A-74780:1996),
- water as determined by oven-drying method in 105°C to constant weight (PN-A-74702:1978),
- fat determined by Soxhlet method (PN-A-74780:1996),
- salt determined by Mohr's method (PN-A-74702:1978),
- protein determined by Kjeldahl's method (PN-75/A-04018:1975/Az3:2002) and
- total ash by incineration in 400°C with prior carbonisation (PN-A-74702:1978).

Carbohydrate content was calculated using Atwater's coefficients of the energetic values of the products in kcal units. The amount of chips with defects and damaged by weight was also determined.

In the second phase of the research, sensory analyses were performed by a team of 10 assessors. The panelists were chosen and trained according to the methodology described in the EN ISO 8586:2014 standard. The panelists assessed the shape and size, colour, odour, taste and texture of the potato chips using a 5-point scale in accordance with Polish Standard PN-A-74780:1996.

The data thus obtained went through statistical analysis. Empirical distributions of the continuous variables were summarised using mean and standard deviations. A one-way ANOVA followed by post hoc Tukey's HSD test was used to compare the means. A p -value of 0.05 was required for statistical significance. Clustering was performed on standardised group averages using hierarchical method with Euclidean distance and complete linkage. All data processing and statistical calculations were performed using R 3.2.3 software.

3. Results and Discussion

The chip production process involves immersing cut potatoes in continuous fryers with oil heated to high temperatures. It usually takes between 1 and 3 minutes for chips to be fried. Such conditions should guarantee the desired colour, texture and moisture loss of less than 2% of the primary water content (Brennan 2006). However, during deep-fat frying, the moisture loss results in oil uptake that may amount to as much as 40% of total product weight (Pedreschi *et al.* 2012, Kita, Lisińska & Gołubowska 2007, Saguy & Dana 2003). High fat content poses the risk of potential adverse health effects for consumers, such as obesity, high blood pressure and coronary disease (Cheng 2012, Sayon-Orea *et al.* 2014,

Stier 2013). The quality of oil used for frying affects the quality of the food (Rani & Chauhan 1995).

The results of the physicochemical analyses are presented in Table 1.

Table 1. Results of Physicochemical Analyses

Parameter	Product							<i>p</i> -value
	A	B	C	D	E	F	G	
Water (%)	1.92 (0.17)	1.63 (0.37)	1.65 (0.08)	1.65 (0.16)	1.79 (0.06)	1.82 (0.07)	2.50 (0.49)	0.001
Total ash (%)	3.78 (0.16)	4.13 (0.65)	3.46 (0.3)	4.41 (0.3)	5.27 (2.56)	3.76 (0.22)	3.17 (1.09)	0.185
Insoluble ash (%)	0.20 (0.22)	0.53 (0.43)	0.63 (0.71)	0.34 (0.28)	0.53 (0.18)	0.32 (0.18)	0.08 (0.08)	0.426
Sodium chloride (%)	2.31 (0.55)	1.69 (0.14)	2.52 (0.21)	2.33 (0.47)	1.49 (0.22)	1.69 (0.23)	2.44 (0.7)	0.003
Protein (%)	5.92 (1.26)	6.40 (0.53)	5.71 (0.62)	5.64 (0.54)	7.05 (1.25)	6.23 (0.91)	6.25 (0.66)	0.298
Fat (%)	38.22 (2.45)	34.38 (6.12)	34.35 (1.84)	31.27 (2.52)	31.8 (0.75)	35.26 (1.91)	36.85 (4.35)	0.051
Carbohydrates (%)	49.80 (2.29)	54.85 (4.43)	53.41 (3.77)	57.89 (2.65)	54.24 (2.24)	52.94 (2.59)	52.09 (3.56)	0.021
Energetic value (kcal/100 g)	568.32 (13.05)	552.06 (36.05)	544.83 (16.83)	532.14 (13.14)	531.33 (7.01)	553.99 (9.03)	564.25 (28.98)	0.075
Acid value, (mg KOH/1 g)	0.57 (0.36)	0.91 (0.36)	0.63 (0.12)	0.50 (0.25)	0.58 (0.09)	0.57 (0.4)	0.35 (0.31)	0.403
Peroxide value (mequiv/kg)	0.70 (0.46)	1.49 (1.23)	1.19 (0.64)	0.55 (0.41)	1.28 (0.81)	1.40 (1.13)	1.04 (0.56)	0.557
Broken parts (%)	46.58 (9.21)	43.18 (5.43)	54.83 (8.42)	40.11 (7.63)	42.38 (14.97)	41.18 (11.04)	47.03 (11.33)	0.510
Defects (%)	18.26 (6.28)	26.99 (10.77)	16.66 (6.11)	19.42 (11.41)	14.5 (8.76)	26.29 (5.72)	17.68 (5.62)	0.317

Source: the authors.

Proteins

Performing numerous essential functions, proteins are crucial components in human nutrition. It has been proved that proteins from potatoes are as nutritious as egg or soy proteins (Waglay & Karboune 2016).

The samples analysed contained a protein content of from 5.64% (sample D) to 7.05% (sample E). However, the differences were insignificant.

Carbohydrates

Carbohydrates are the main source of energy for the human body. Concentrations of carbohydrates ranged from 49.8% (sample A) to 57.89% (sample D). The differences between samples A and D were statistically significant.

Minerals

Minerals are essential elements of the human diet. They play an important role in the maintenance of physicochemical conditions crucial for sustaining life (Ikanone & Oyekan 2014). Total ash content enables their concentration in a food product to be estimated.

Total ash content varied from 3.17% (sample G) to 5.27% (sample E). The differences were statistically insignificant.

Insoluble ash is an indicator of product contamination, mainly with quartz components. In case of potato chips, the presence of quartz may indicate that the raw material washing process was done sloppily.

Insoluble ash content ranged from 0.08% (sample G) to 0.63% (sample C). As with total ash, the differences were statistically insignificant.

Sodium Chloride

Sodium ions are necessary to maintain blood pressure and volume. They are also used by the nervous system to enable the transmission of impulses and are needed for the metabolism of carbohydrates and proteins. On the other hand, too much sodium consumed with food may cause hypertension or high blood pressure (Beernaert, Van der Mijnsbrugge & De Martelaere 1984). Currently, the advised maximum intake of salt is 6 g a day (*Referencyjne wartości...* 2016).

According to Polish Standard PN-A-74780, the salt content in potato chips may not exceed 3.5%. The highest sodium content was determined in products G (2.44%) and C (2.52%), while the lowest occurred in product E (1.49%). Differences between the two samples of the highest sodium chloride concentration and the product of the lowest sodium chloride content were statistically significant. The sodium chloride content in all of the samples leads to the conclusion that eating potato chips adds a significant amount of this compound to one's daily diet.

The salt content in potato chips analysed by Wójcik-Stopczyńska and Grzeszczuk (2003) ranged from 0.69% to 2.66%. However, their sample was flavoured potato chips.

Moisture and Fat

Moisture and fat content are two common parameters used to monitor potato chip quality (Shiroma & Rodriguez-Saona 2009).

Fat content is one of the most important parameters checked during the quality control process. It affects the product's texture (Mazurek, Szostak & Kita 2016). The fat content alongside potato chips' thinness gives them a desirable flavour-texture combination (Pedreschi *et al.* 2012). Most of the oil does not penetrate into the microstructure of potato chips during the frying but during cooling (Pedreschi *et al.* 2008, Durán *et al.* 2007). Commercial potato chips vary in fat content. Low-fat products contain up to 10% fat, while regular chips as much as 30–40%. The factors that influence fat uptake include: the quality of the raw material, the type of oil fraction, and technological process – with temperature and frying time being the two main parameters (Mazurek, Szostak & Kita 2016, Kita, Lisińska & Gołubowska 2007).

According to Polish Standard PN-A-74780, fat content in potato chips must not exceed 45%. In our research, the products contained from 31.27% (sample D) up to 38.22% (sample A). Only these two marginal products had a statistically significant difference (A and D).

The mean fat content in potato chips tested by Wójcik-Stopczyńska and Grzeszczuk (2003) ranged from 33.14% to 33.94%, while those analysed by Ratusz and Wirkowska (2008) came in at a far wide range – from 22.9% to 40.1% – and by Zychnowska, Krygier and Iwańczuk (2015) from 27% to 36%.

Chips with a moisture content above 3% cannot be sold as their texture becomes unacceptable for consumers (Matz 1984). Moreover, through acceleration of fat degradation, high water content reduces product shelf life (Wójcik-Stopczyńska & Grzeszczuk 2003).

According to Polish Standard PN-A-74780, water content in potato chips must not exceed 4%. In this research, the statistically significantly highest water content was detected in product G (2.5%). Other samples contained from 1.63% (product B) to 1.92% (product A) of water.

In the research by Wójcik-Stopczyńska and Grzeszczuk (2003), water content in potato chips ranged from 0.76% to 3.29%.

Peroxide Value and Acid Value

During deep-frying in the presence of moisture and air, a number of chemical reactions, including oxidation and hydrolysis, occur. The thermal decomposition of fats leads to an increase in the acid and peroxide values (Zhang *et al.* 2015, Lalas & Dourtoglou 2003).

The levels of lipid oxidation along with sorbed water content influence potato chip quality (Quast, Karel & Rand 1972). The lipid oxidation rate depends on the partial pressures of oxygen and water as well as the extent of the oxidation reactions (Del Nobile 2001). To protect chips from breakage and spoilage, they are packed in polymeric films with inert gas, thus keeping the oxygen and water

partial pressures at a low level. This slows down the lipid oxidation rate, extending the product's shelf-life (Del Nobile 2001).

Determining the peroxide value (PV) in foods containing fats is of utmost importance from a quality assurance perspective. This parameter reflects the amount of oxidation in products, mainly hydroperoxides and secondary oxidation products (ketones and aldehydes) in fat. These compounds deteriorate flavour (Guillén & Cabo 2000, Mehta, Darji & Aparnathi 2015). Oxidative processes may occur during storage and processing through auto- or photo-oxidation (Choe & Min 2006). The higher the PV, the lower the food oxidative stability affecting product quality (Pizarro *et al.* 2013). The oxidation of fat in food may even result in product toxicity (Yang *et al.* 2014).

According to the Polish Standard PN-A-74780, the PV in potato chips must not exceed 6 mequiv/kg. All seven of the potato chip samples met this requirement. Although some differences between the samples were found, they were statistically insignificant. At 0.55 mequiv/kg, product D had the lowest mean PV while B had the highest (1.48 mequiv/kg). Relatively high standard deviations indicated that there were large fluctuations between the samples of different production batches.

Wójcik-Stopczyńska and Grzeszczuk (2003) noted mean values ranging from 2.02 mequiv/kg to 4.04 mequiv/kg, with two products in the single production batches (8.08 mequiv/kg and 9.18 mequiv/kg) exceeded the limit set by the PN-A-74780 standard. In research done by Zychnowska, Krygier and Iwańczuk (2015), two products had a peroxide value slightly above the limit set by the Polish Standard (6.09 mequiv/kg and 6.17 mequiv/kg) and in one case the limit was exceeded significantly (10.11 mequiv/kg). The PV determined for other products ranged from 1.09 mequiv/kg to 5.31 mequiv/kg.

Acid value (AV) indicates the amount of free fatty acids in the food products. The lower the value, the higher the quality of the fat contained in the food. High AV may cause gastrointestinal discomfort, diarrhea and even liver damage (Zhang *et al.* 2015).

According to Polish Standard PN-A-74780, the AV in potato chips must not exceed 1 mg KOH/g. All of the samples were analysed with a view to ensuring this requirement was met. The lowest value was determined for product G (0.35 mg KOH/g) and the highest for product B (0.91 mg KOH/g), though the differences were insignificant. High standard deviations indicated that the quality differed from production batch to batch.

In research done by Wójcik-Stopczyńska and Grzeszczuk (2003), the mean acid value ranged between 0.56 mg KOH/g and 0.7 mg KOH/g. They determined that in single batches of two products, AV exceeded the 1 mg KOH/g limit. The acid value noted in potato chips analysed by Zychnowska, Krygier and Iwańczuk

(2015) fluctuated between 0.25 mg KOH/g and 0.69 mg KOH/g. One product had an acid value above the limit set by the PN-A-74780 standard (1.53 mg KOH/g).

Energetic Value

The high concentration of fat in potato chips results in their having high energetic value, which for the products analysed here ranged from 531.3 kcal/100 g (product E) to 568.3 kcal/100 g (product A). Nevertheless, the differences between the tested samples were statistically insignificant.

Chips with Defects and Damaged

According to Polish Standard PN-A-74780, the number of broken potato chips per package must not exceed 8% and chips with defects cannot exceed 0.8%. For this research, all damaged potato chips were counted, even those with small missing pieces. The number of broken chips ranged from 40.11% (sample D) to 54.83% (sample C) while the percentage of chips with defects ranged from 14.5% (sample E) to 26.99% (sample B).

As in the research by Wójcik-Stopczyńska and Grzeszczuk (2003), the majority (85%) of analysed products did not meet requirements of the PN-A-74780 standard.

Sensory Characteristics

The process of frying potato chips gives them a unique appearance, flavours and texture, leading to a highly palatable product. The appreciated colour and mechanical characteristics are developed when the product is being fried (Yu *et al.* 2016).

Consumers are the final judge of any product, the sensory characteristics of which play a crucial role in purchasing decisions (Gatchalian 1999). It is difficult to replace a human sensory evaluation with instrumental methods (Mehta, Darji & Aparnathi 2015). Nonetheless, the producer needs to evaluate sensory quality that affects the level of its product's acceptability. In the case of potato chips, the following parameters are evaluated: shape and size, colour, odour, taste, and texture.

The results of sensory analysis are presented in Table 2.

Table 2. The Results of Sensory Analysis

Parameter	Product							p-value
	A	B	C	D	E	F	G	
Shape and size	2.75 (0.5)	2.00 (0.82)	2.38 (0.48)	3.00 (1.00)	4.67 (0.58)	3.2 (0.84)	2.00 (0.00)	0.001
Colour	3.62 (0.48)	2.80 (0.84)	3.62 (1.25)	3.50 (1.00)	4.00 (0.00)	2.90 (0.55)	2.50 (0.58)	0.086

Parameter	Product							<i>p</i> -value
	A	B	C	D	E	F	G	
Odour	4.00 (0.00)	3.20 (0.84)	4.12 (0.85)	4.62 (0.48)	4.38 (0.48)	3.90 (0.74)	3.38 (0.75)	0.049
Taste	4.00 (0.00)	3.20 (0.84)	4.00 (0.82)	5.00 (0.00)	5.00 (0.00)	3.80 (0.57)	3.50 (0.58)	0.001
Texture	4.00 (0.41)	3.80 (0.45)	4.25 (0.50)	4.62 (0.48)	4.75 (0.50)	3.70 (0.67)	3.75 (0.50)	0.027
SQI	3.67 (0.15)	3.07 (0.48)	3.68 (0.41)	4.22 (0.31)	4.54 (0.23)	3.50 (0.48)	3.02 (0.26)	0.001

Source: the authors.

Shape and Size

Product E scored the highest for shape and size (4.67 points). Product B (2 points) had the lowest score in the group, while G (2 points), C (2.38 points) and A (2.75 points) had statistically significantly lower scores.

In both Wójcik-Stopczyńska and Grzeszczuk's (2003) and Mozolewski, Wieczorek and Pomianowski's research (2011), all of the products analysed returned scores below 3 points.

Colour

Colour and appearance are the first quality parameters assessed by consumers before a food is consumed (Pedreschi *et al.* 2006; Demattè, Sanabria & Spence 2009). Consumers often associate colour with flavour, safety, nutrition and satisfaction (Pedreschi *et al.* 2012). Therefore, sensory evaluation of colour is often used in product quality control (Murray, Delahunty & Baxter 2001). According to Pedreschi *et al.* (2006), the colour of potato chips is the first and most critical product feature assessed by consumers and influences product acceptance.

The Maillard reaction between reducing sugars and amino acids has a great influence on chip colour. The amount of these compounds in chips along with the time and temperature of frying go a long way to obtaining an appealing colour (Marquez & Añon 1986). The colour on the surface of potato chips is also highly dependent on the amount and location of the oil in the product's microstructure (Pedreschi *et al.* 2012).

The results of research by Pedreschi *et al.* (2012) prove that pale chips are less appreciated by consumers as they do not have a rich odour. 80% of panelists rejected such products. As many as 60% claimed that potato chips had to be toasted and of golden brown colour, though not burnt.

In the present study, the colour of products A and C received the highest ratings (mean – 3.62 points) while product samples G and B (2.5 points) returned the lowest scores, though the differences were statistically insignificant.

In Mozolewski, Wieczorek and Pomianowski's study (2011), the potato chips received ratings from 2.6 to 3.1 points.

Odour

The odour of fried potato chips is formed in Strecker's reactions, where methional is formed from methionine (Duckham *et al.* 2002).

Sample D had the highest-ranking odour (4.62 points) among the products analysed. Product B (mean – 3.2 points) received the lowest scores among all the samples, though products B and D were the only two to have a statistically significant difference.

In research done by Wójcik-Stopczyńska and Grzeszczuk (2003) on chips of various flavours, the mean odour scores ranged from 4.19 to 4.54 points. In Mozolewski, Wieczorek and Pomianowski's 2011 study, the chips were scored from 3.1 to 3.8 points.

Taste

Consumers naturally perceive a food product's taste to be amongst the most crucial determinants affecting their choice to purchase and consume it (Thunström & Nordström 2015). The taste of salted potato chips depends mainly on precursors of aromatic compounds in potatoes as well as the type and quality of oil used and the amount of salt added (Lisińska 1994, Jansky 2010).

Products D and E earned the highest ratings for taste (5 points), while products B (3.2 points), G (3.5 points) and F (3.8 points) all garnered significantly lower scores.

In research by Mozolewski, Wieczorek and Pomianowski (2011), potato chips received scores of between 3.1 and 3.8 points.

Texture

Apart from colour, odour and flavour, texture is an important feature of potato chips and influences consumer acceptance (Kita 2001). According to Scanlon *et al.* (1994), colour and texture are actually the most important sensory parameters of potato chips.

The texture of potato chips is often associated with crispiness, hardness and crunchiness (Salvador *et al.* 2009). Crispiness is a very important quality of potato chips (Yu *et al.* 2016). Both the raw materials in the chips and the conditions present in the manufacturing process affect chip crispiness (Segnini, Dejmek & Öste 1999). According to research by Salvador *et al.* (2009), high fat content makes chips less crispy.

According to the assessors, potato chips E had the best texture (4.75 points), while product F, with a mean score of 3.7, had the worst.

In research by Wójcik-Stopczyńska and Grzeszczuk (2003), all of the potato chips received ratings higher than 4 points, whereas in a study done by Mozolewski, Wieczorek and Pomianowski (2011), the scores ranged from 2.5 to 4.0 points.

SQI

Product E had the highest sensory quality of all the brands (SQI – 4.54 points) while samples B and G were assessed as being of the worst sensory quality (3.07 points and 3.02 points respectively). According to Polish Standard PN-A-74780, products A, B, C, F and G should be disqualified for the shape and size as well as colour ratings.

In Wójcik-Stopczyńska and Grzeszczuk's 2003 research, overall ratings for flavoured potato chips ranged between 3.73 and 4.21 points and in Mozolewski, Wieczorek and Pomianowski's 2011 the ratings were lower, at between 2.84 and 3.44 points.

Hierarchical Clustering

The results of hierarchical clustering show that the chips analysed here can be divided into two groups of similar products (see Figure 1). The first cluster (D and E) is made up of well-known, high quality products, while the second contains A, B, C, F and G, products sold at the lowest price. Four of them – A, C, F and G – were private label products.

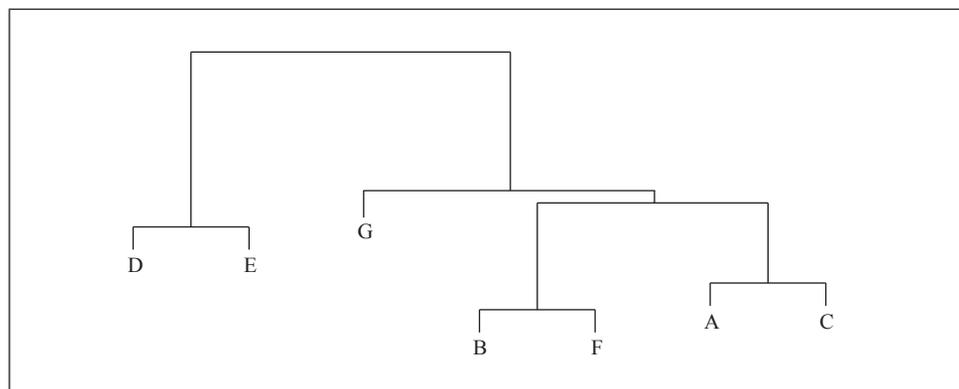


Fig. 1. Dendrogram of Hierarchical Clustering Results

Source: the authors.

4. Conclusions

Today's consumers choose food that has desirable sensory properties. Nevertheless, more and more people are beginning to realise that nutrition affects their health. Potato chips are not an advisable part of one's everyday diet. Nonetheless, their unique sensory characteristics have led to high consumption rates.

Among commercially available potato chips, differences regarding quality, nutritional value and sensory properties may be found. The highest nutritional value is found in products that cannot be classified as actual potato chips: those made of potato flour and baked, which have a lower fat content and are highly appreciated by consumers, a fact borne out by the results of analyses conducted for product E.

While the products sold by well-known manufacturers were of the highest sensory quality among the samples analysed for this paper, delicatessen brands were very similar. This was also confirmed by the results of hierarchical clustering.

The nutritional value of the potato chips was similar, though there were statistically significant differences in the particular parameters of single products. Finally, the differences in salt content in some cases came in at as much as 40%. In case of salted potato chips, the concentration of sodium chloride might be an important selection criterion among consumers.

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Jakość solonych chipsów ziemniaczanych dostępnych na polskim rynku

(Streszczenie)

Chipsy ziemniaczane są powszechnie znaną przekąską konsumowaną przez ludzi w każdym wieku. Ze względu na dużą zawartość tłuszczu oraz soli, a także zawartość akryloamidu i izomerów trans kwasów tłuszczowych powstających w wyniku smażenia w wysokiej temperaturze uważa się je za produkt niezdrowy. Mają one jednak bardzo pożądaną smak, często poprawiony przez dodatek glutamianu sodu, i dlatego wielkość ich spożycia utrzymuje się stale na wysokim poziomie.

Na polskim rynku funkcjonuje wiele firm, które produkują chipsy ziemniaczane, jest to bowiem istotny produkt na rynku żywności. Dostępne na rynku chipsy ziemniaczane różnią się jednak istotnie pod względem ceny, a także deklarowanej wartości odżywczej. Celem badań była ocena jakości solonych chipsów ziemniaczanych dostępnych na polskim rynku. Wybrano 8 produktów oferowanych przez 7 producentów. Próbkę pobierano z czterech partii produkcyjnych. Analizie poddano wartość odżywczą chipsów, a także oznaczono liczby: kwasową i nadtlenkową wyekstrahowanego z nich tłuszczu. Ponadto zweryfikowano jakość sensoryczną, liczbę chipsów z wadami i uszkodzonymi, a także szczelność opakowania. Wyniki dowodzą, że solone chipsy dostępne na polskim rynku istotnie różnią się między sobą zawartością wybranych składników odżywczych i jakością sensoryczną.

Słowa kluczowe: przekąski, chipsy ziemniaczane, solone chipsy ziemniaczane, jakość chipsów ziemniaczanych.