ACTA SCIENTIARUM POLONORUM *Acta Sci. Pol., Technol. Aliment. 3(1) 2004, 157-165*

THE ESTIMATION OF SOME CONSTITUENTS CONTENTS IN MINIMALLY PROCESSED VEGETABLE SALADS PURCHASED IN THE RETAIL NETWORK

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Abstract. Fourteen kinds of "ready to eat" minimally processed vegetable salads (7 days of use-fulness) manufactured by two companies were the material of this investigation. The content of dry matter, total protein, total sugars, crude fibre, total ash, ascorbic acid, nitrates and nitrites were examined. Significant differences between average content of the investigated constituents in dependence on kind of salads were stated. Ascorbic acid content was in range 2.04-30.30 mg·100 g^{-1} and most of salads (portion of 100 g) might provide 20-40% of the recommended daily dose of ascorbic acid. The quantity of nitrates oscillated between 184.9-768.6 mg $NaNO_3 \cdot kg^{-1}$ and could be qualified as low to middle-high. Nitrites were absent in most of tested salads and in the others their quantity was low (0.20-0.83 mg $NaNO_2 \cdot kg^{-1}$).

Key words: vegetable salads, minimal processing, chemical constituents

INTRODUCTION

A lot of contemporary consumers need food which is characterized by convenience (ready to use) and also fresh natural look and high nutritive value. Minimal processing is the answer to these expectations and ready to eat vegetable salads are an important group of minimally processed vegetables. The production of this kind of food is carried out with reduced heat treatment but ought to give to salads microbiological safety and not less than 5-7 days of usefulness. Minimal processing of vegetables includes any unit operations like cleaning, washing, peeling, coring, slicing, rinsing to remove cellular fluids, drying by centrifuging and sometimes slight blanching (50-60°C). Washing is usually connected with the desinfection (in chlorine water). Acidifying by dipping vegetables slices in 0.5% water solution of citric acid is also employed. So called "clean room technology" is recommended for mixing salads compo-nents (slices of vegetables,

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spices, salad oil or mayonnaise) and packing products [Czapski 1997, Janicki 1999 b]. Fundamental agents which affect quality of salads are high quality of raw materials, right technology operations (especially high sanitary conditions) and keeping low temperature (0-4°C) between producer and consumer [Ahvenainen 1996]. Observance of "cooling chain" and also packing in modified atmosphere retards microorganisms' proliferation and enzymatic and physiological changes which take place in the tissues [Howard et al. 1994, Czapski 1997].

In opinion of Janicki (1999 b) there are 300-400 kinds of minimally processed vegetables and fruits in the countries of Western Europe. In Poland these products are relatively new but offer of ready to eat minimally processed vegetable salads is rather numerous. However, data about their microbiological quality, as well as nutritive value are rare [Kordowska-Wiater and Witczyk 2002]. The content of different constituents (both nutritious and unwholesome ones) in vegetable salads can depend mainly on their quantity in raw material, vegetable composition of products, processes occurring in cells and technological treatments.

Commodity investigations were taken up in this work and their aim was the estimation of some nutritious and unwholesome constituents content in the minimally processed vegetable salads.

Table 1. Vegetable composition of the tested salads
Tabela 1. Skład warzyw w badanych surówkach

Salads of "A" producer – Surówki producenta „A"						
Wiejska	koperkowa	wenecka	wiedeńska	żydowska	porowa	selerowa
White cabbage, carrot, parsley leaves, leek Kapusta biała, marchew, zielona pietruszka, por	white cabbage, carrot, dill leaves kapusta biała, marchew, koperek	white cabbage, carrot, leek, sweet corn, red bean kapusta biała, marchew, por, kukurydza, czerwona fasola	white cabbage, tinned cucumber, paprika kapusta biała, ogórek konserwowy, papryka	white cabbage, pickled cucumber, carrot, celery, leek, parsley, apple kapusta biała, ogórek kiszony, marchew, seler, por, pietruszka, jabłko	leek, white cabbage por, kapusta biała	celery, apple seler, jabłko
Salads of "B" producer – Surówki producenta „B"						
Wiejska	bułgarska	królewska	pekińska	francuska	meksykańska	bankietowa
White cabbage, carrot Kapusta biała, marchew	white cabbage, parsley leaves, paprika kapusta biała, zielona pietruszka, papryka	white cabbage, carrot, parsley leaves, leek kapusta biała, marchew, zielona pietruszka, por	chinese cabbage, carrot kapusta pekińska, marchew	white cabbage, carrot, celery, parsley leaves kapusta biała, marchew, seler, zielona pietruszka	white cabbage, carrot, sweet corn kapusta biała, marchew, kukurydza	chinese cabbage, pickled cucumber, paprika kapusta pekińska, ogórek kiszony, papryka

MATERIAL AND METHODS

The study included 14 "ready to eat" minimally processed vegetable salads (7 days of usefulness) manufactured by two producers. The samples (about 1 kg weight) of salads were bought in the shops of Szczecin (on the second day after production) in different months (January-May) of 2003. Table 1 shows vegetable composition of each salad. Spices (without a specification by producers), cooking oil or mayonnaise were also the compounds of the tested products.

The content of following constituents was examined by methods of Krełowska-Kułas [1993]: dry matter (by weight method), total protein (Kjeldahl's method), total sugars (Luff-Schoorl's method), crude fibre (Kürschner-Scharrer's method), total ash (by incineration of samples in 500-525°C), ascorbic acid (Tillmans' method). The quantity of nitrates and nitrites was also determined by colorimetric method [PN-92/A75112] on the basis on Griess reaction (sulphanic acid and N-1-naphtyl-ethylene-diamine were used).

The investigations were carried out in 3 replications. Data were statistically examined by analysis of variance and significant differences between means were evaluated using the Tukey test at a significance level $\alpha = 0.05$.

RESULTS AND DISCUSSION

The results of this work (Table 2 and 3, Fig. 1 and 2) demonstrate that the contents of the investigated constituents were differentiated. The differences between average quantity of the tested constituents in dependence on kind of salads were significant.

The dry matter content (Table 2) oscillated between 12.72% in "wiejska" salad of A producer (consisted mainly of white cabbage and carrot) and 21.02% in "selerowa" salad (composed of celery and apple). Salads of "A" and "B" producers had average quantity of dry matter respectively 16.05 and 15.88%. The lowest level of total protein (0.90%) was stated in "selerowa" salad and highest content of this component (1.62%) had "wiejska" salad (of B producer). Average contents of total sugars in salads of both producers were similar (8.63 and 8.84%). Least of sugars (5.72%) had "bankietowa" salad (consisted of Chinese cabbage, pickled cucumber and paprika) and the highest level of them (10.00%) was found in "meksykańska" salad (with addition of sweet corn).

Vegetables and vegetable products are an important source of food fibre and mineral substances which have valuable alkalescent properties [Janicki 1999 a]. The highest content of crude fibre (3.34%) had "wenecka" salad with addition of red bean and least of this constituent (0.87%) was stated in "żydowska" salad. The average content of crude fibre in salads of "A" and "B" producers had the level respectively 2.05 and 1.64%. The total ash content oscillated between 1.06% (in "pekińska" salad) and 1.95% (in "wiejska" salad of "B" producer). Average level of ash in salads of "B" producer was a little higher (1.47%) than in salads of "A" producer (1.31%).

The losses of dry matter constituents can occur during minimal processing of vegetables. Flowing out cellular fluid during cutting of vegetables, rinsing soluble substances while washing up vegetable slices, physiological and enzymatic processes in cells are the main reasons of constituents decreases. It was stated [Janicki 1999 a] that the mineral substances losses come up 10-15%.

Table 2. The content of dry matter and some of other constituents in the tested salads of both producers
Tabela 2. Zawartość suchej masy oraz niektórych innych składników w badanych surówkach dwóch producentów

Name of salad Nazwa surówki	Dry matter, % Sucha masa, %	Total protein % f.w. Białko ogółem % św.m.	Total sugars % f.w. Curky ogółem % św.m.	Crude fibre % f.w. Błonnik surowy % św.m.	Total ash % f.w. Popiół ogólny % św.m.
Salads of "A" producer – Surówki producenta „A"					
Wiejska	12.72	1.13	7.52	1.02	1.41
Koperkowa	16.62	1.20	9.,35	2.67	1.25
Wenecka	17.78	1.35	9.11	3.34	1.26
Wiedeńska	15.67	1.19	8.92	2.42	1.09
Żydowska	13.05	1.14	8.34	0.87	1.48
Porowa	15.51	1.21	8.37	2.84	1.14
Selerowa	21.02	0.90	8.54	1.22	1.52
$LSD_{0.05}$ – $NIR_{0,05}$	0.27	0.22	0.31	0.52	0.21
Salads of "B" producer – Surówki producenta „B"					
Wiejska	15.79	1.62	8.52	2.14	1.95
Bułgarska	15.17	1.46	8.35	2.26	1.52
Królewska	14.88	1.28	9.51	1.45	1.25
Pekińska	16.23	1.39	9.97	2.43	1.06
Francuska	16.09	1.17	9.28	0.99	1.56
Meksykańska	17.42	1.25	10.00	1.02	1.68
Bankietowa	14.49	1.10	5.72	1.18	1.28
$LSD_{0,05}$ – $NIR_{0,05}$	0.25	0.26	0.18	0.20	0.13

Table 3. The content of nitrates and nitrites in the tested salads
Tabela 3. Zawartość azotanów i azotynów w badanych surówkach

Kind of constituents Składnik	Salads of "A" producer – Surówki producenta „A"							
	wiejska	koperkowa	wenecka	wiedeńska	żydowska	porowa	selerowa	$LSD_{0.05}$ $NIR_{0,05}$
mg $NaNO_3 \cdot kg^{-1}$ f.w.	323.3	643.2	664.4	768.6	652.1	246.6	588.4	332.6
mg $NaNO_2 \cdot kg^{-1}$ f.w.	–*	–	–	–	–	–	0.83	
	Salads of "B" producer – Surówki producenta „B"							
	wiejska	bułgarska	królew-ska	pekińska	francuska	meksy-kańska	bankie-towa	$LSD_{0.05}$ $NIR_{0,05}$
mg $NaNO_3 \cdot kg^{-1}$ f.w.	184.9	402.7	538.4	611.0	204.1	312.3	202.1	93.3
mg $NaNO_2 \cdot kg^{-1}$ f.w.	0.83	0.47	0.20	–	0.57	–	0.63	0.32

*Absent.
*Nieobecne.

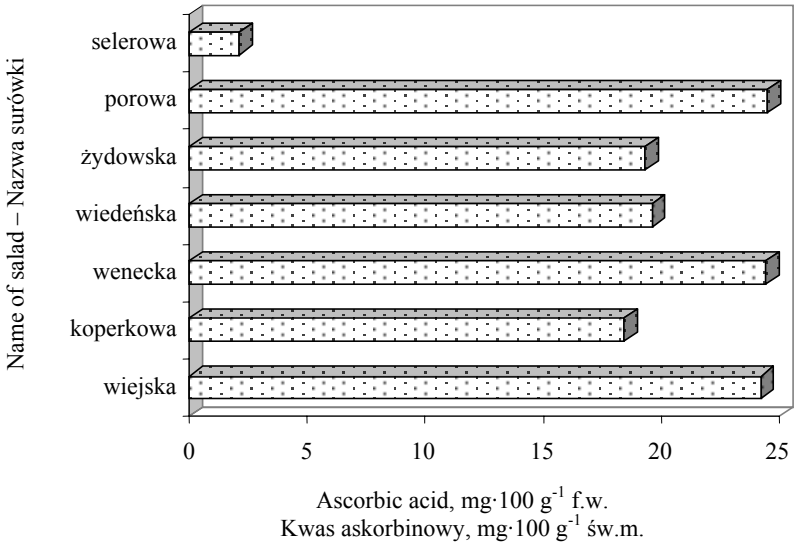

Fig. 1. Ascorbic acid content in salads of "A" producer ($LSD_{0.05}$ = 1.57)
Rys. 1. Zawartość kwasu askorbinowego w surówkach producenta „A" ($NIR_{0,05}$ = 1,57)

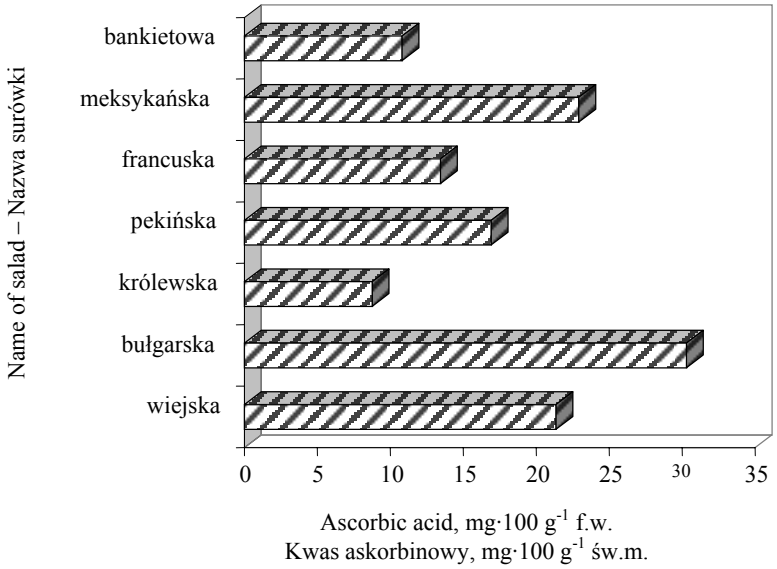

Fig. 2. Ascorbic acid content in salads of "B" producer ($LSD_{0.05}$ = 2.68)
Rys. 2. Zawartość kwasu askorbinowego w surówkach producenta „B" ($NIR_{0,05}$ = 2,68)

In order to evaluate the contents of dry matter, total protein, sugars and ash and crude fibre which were stated in tested vegetable salads it is reasonable to compare their quantities to levels in raw vegetables shown in the tables of nutritive value [Kunachowicz et al. 1998]. White cabbage, carrot, Chinese cabbage, celery and leek were dominant quantitative components of the investigated salads (Table 1). There are following contents of some constituents in 100 g of edible parts of these vegetables: dry matter – from 5.6% in Chinese cabbage to about 10.3% in white cabbage, carrot and celeriac, total protein – from 1.0% in carrot to 1.6-1.7% in white cabbage and celeriac, total sugars – from 3.2% in Chinese cabbage to 8.7% in carrot, total ash – from 0.4% in carrot to 0,9% in white cabbage, celeriac and leek, crude fibre – from 1.0% in white cabbage to 1.3% in celery [Kunachowicz et al. 1998]. The comparison of these quantities with results of this study (Table 2) shows that the contents of the investigated constituents in salads were often similar or even higher than communicated for main raw materials (in spite of possible losses during production). Dehydration of vegetables slices surface may have provided to concentration of constituents [Howard and Dewi 1995]. A participation of other vegetables (sweet corn, red bean, parsley leaves, dill, paprika, tinned or pickled cucumber – Table 1) and addition of spices also could influence on final contents of constituents in the tested salads.

Vegetables and fruits are the main source of ascorbic acid. The content of this compound in salads of "A" and "B" producer (Fig. 1 and 2) ranged respectively between 2.0-24.4 mg·100 g^{-1} (mean 18.9 mg·100 g^{-1}) and 8.8-30.3 mg·100 g^{-1} (mean 17.8 mg·100 g^{-1}).

Vegetable composition of salads (the kind of vegetables) and dimension of losses of ascorbic acid during technological operations could affect differentiation of this constituent content in the tested salads. The lowest quantity of ascorbic acid had "selerowa" salad composed from celery and apple. These raw materials have only about 8-9 mg·100 g^{-1} of vitamin C [Kunachowicz et al. 1998]. The highest level of ascorbic acid was stated in "bułgarska" salad. Parsley leaves and paprika which were components of this salad have a lot of vitamin C, suitably 177 and 144 mg·100 g^{-1} [Kunachowicz et al. 1998].

The quantity of ascorbic acid in investigated salads was lower than communicated for raw vegetables [Kunachowicz et al. 1998]. The content of vitamin C in raw materials can change in dependence on vegetables' length of storage period before their processing [Janicki 1999 b]. The decreases of ascorbic acid during minimal processing take place especially while peeling, cutting and crumbling of vegetables. Washing up and rinsing of vegetable slices are also important [Janicki 1999 b, Czarniecka-Skubina and Gołaszewska 2001]. The employment of blanching can increase the losses of vitamin C. Janicki [1999 b] communicated that after slicing and blanching of cabbage the losses of ascorbic acid received respectively 15% and 35-40%.

In opinion of Wartanowicz [2003] daily intake of vitamin C by the adults ought to come up 70-80 mg. Most of the tested salads (portion 100 g) could provide about 20--40% of this recommended daily dose.

Vegetables can also be the source of unwholesome substances, for example nitrates and nitrites. The data of investigations carried out by Wawrzyniak et al. [1999] prove that vegetables and vegetable products can constitute over 90% of total quantity of nitrates and about 15-20% of nitrites in the human daily diet.

The content of nitrates in the tested salads of "A" and "B" producer oscillated in wide range, suitably 246.6-768.6 mg $NaNO_3 \cdot kg^{-1}$ and 184.9-611.0 mg $NaNO_3 \cdot kg^{-1}$ (Table 3). These results show that presumably in raw materials, used in a production of salads, the quantity of nitrates was very differentiated. Many agents, also independent on a human activity (for example the climatic conditions), influence on the level nitrates in vegetables [Lisiewska and Kmiecik 1991]. Therefore, a quantity of these constituents in vegetables can be variable and often relatively high [Nabrzyski and Gajewska 1994, Rutkowska 1999]. Vegetables differ in ability of accumulating nitrates. Taking this fact into account Decree of Minister of Health [Rozporządzenie... 2000] mentions the highest acceptable quantities of nitrates in particular groups of vegetables. For example in vegetables which were the components of the tested salads the contents of nitrates should not be higher than: 2000 mg $NaNO_3 \cdot kg^{-1}$ in dill, 1000 mg $NaNO_3 \cdot kg^{-1}$ in cabbage, 500 mg $NaNO_3 \cdot kg^{-1}$ in carrots, celery, leek and parsley, 250 mg $NaNO_3 \cdot kg^{-1}$ in paprika, bean and also in vegetable products for children. The comparison of this work data (Table 3) with the above numbers shows that the quantities of nitrates in investigated salads can be qualified as low to middle-high. However, the level of nitrates in celery salad (588,4 mg $NaNO_3 \cdot kg^{-1}$) may evoke doubt. It is possible that celery used in the production of this salad had an excessive (> 500 mg $NaNO_3 \cdot kg^{-1}$) content of nitrates.

The range of technological treatment of vegetables during producing salads could also affect the level of nitrates in the final products. The results of the investigations carried out by various authors [Szponar et al. 1981, Markowska et al. 1995, Czarniecka-Skubina and Gołaszewska 2001] show that peeling, washing and especially blanching vegetables reduced the content of nitrates and nitrites, as well.

Nitrites were absent in most of the tested salads, mainly of "A" producer (Table 3). Their quantity in the others oscillated from 0.20 to 0.83 mg $NaNO_2 \cdot kg^{-1}$. This level can be qualified as low. In raw vegetables the quantity of nitrites about 1-2 mg $NaNO_2 \cdot kg^{-1}$ is normal [Lisiewska and Kmiecik 1991, Rutkowska 1999] and the acceptable content of nitrites in vegetable products for children should not be higher than 1.0 mg $NaNO_2 \cdot kg^{-1}$ [Rozporządzenie... 2000].

RECAPITULATION

1. The contents of investigated constituents in tested salads were differentiated: dry matter 12.72-21.02%, total protein 0.90-1.62%, total sugars 5.72-10.80%, total ash 1.06-1.95% and crude fibre 0.87-3.34%. It was stated that differences between average content of all estimated constituents in dependence on kind of salads were significant. Vegetable composition of salads, the content of particular constituents in raw vegetables and technological operations could influence final levels of the investigated substances in salads.

2. The quantity of ascorbic acid oscillated in wide range from 2.04 $mg \cdot 100\ g^{-1}$ in celery salad to 30.30 $mg \cdot 100\ g^{-1}$ in salad with addition of parsley leaves and paprika. Most of salads (portion 100 g) might provide about 20-40% of the recommended daily dose of vitamin C.

3. The content of nitrates ranged between 184.9-768.6 mg $NaNO_3 \cdot kg^{-1}$ and could be qualified as low and middle-high. Nitrites were absent in most of the tested salads and in the others their quantity was low (0.20-0.83 mg $NaNO_2 \cdot kg^{-1}$).

REFERENCES

Ahvenainen R., 1996. New approaches in improving the shelf life of minimally processed fruits and vegetables. Trends Food Sci. Technol. 7(6), 179-187.
Czapski J., 1997. Warzywa o małym stopniu przetworzenia. In: Mater. Konf. Nauk. „Żywność minimalnie przetworzona". 19-20 czerwca, Kraków, 113-121.
Czarniecka-Skubina E., Gołaszewska B., 2001. Wpływ procesu kulinarnego na jakość wybranych warzyw. Żywność 2 (27), 103-116.
Howard L.R., Dewi T., 1995. Sensory, microbial and chemical quality of mini-peeled carrots as affected by edible coating treatment. J. Food Sci. 60 (1), 142-144.
Howard L.R., Yoo K.S., Pike L.M., Miller G.H., 1994. Quality changes in diced onions stored in film packages. J. Food Sci. 59 (1), 110-112.
Janicki A., 1999 a. Składniki mineralne a procesy technologiczne. In: Składniki mineralne w żywieniu człowieka. Red. A. Brzozowska. Wyd. AR Poznań, 64-81.
Janicki A., 1999 b. Żywność minimalnie przetworzona. In: Żywność wygodna i żywność funkcjonalna. Red. F. Świderski. WNT Warszawa, 133-148.
Kordowska-Wiater M., Witczyk J., 2002. Ocena jakości mikrobiologicznej surówek warzywnych gotowych do spożycia. In: Materiały XXXIII Sesji Naukowej KTiChŻ PAN „Nauka o żywności. Osiągnięcia i perspektywy". 10-11 września, Lublin, 260.
Krełowska-Kułas M., 1993. Badanie jakości produktów spożywczych. PWE Warszawa.
Kunachowicz H., Nadolna I., Przygoda B., Iwanow K., 1998. Tabele wartości odżywczej produktów spożywczych. Wyd. Instytutu Żywienia i Żywności Warszawa.
Lisiewska Z., Kmiecik W., 1991. Azotany i azotyny w warzywach. Cz. I. Wpływ różnych czynników na zawartość azotanów i azotynów w warzywach świeżych. Post. Nauk Roln. 3, 11-24.
Markowska A., Kotowska A., Furmanek W., Gackowska L., Siwek B., Kacprzak-Strzałkowska E., Błońska A., 1995. Badania zawartości azotanów i azotynów w wybranych warzywach surowych oraz poddanych obróbce termicznej. Rocz. PZH 46, 349-355.
Nabrzyski M., Gajewska R., 1994. Zawartość azotanów i azotynów w owocach i warzywach oraz w niektórych innych środkach spożywczych. Rocz. PZH 45 (3), 167-180.
PN-92/A-75112 (1992). Owoce, warzywa i ich przetwory. Oznaczanie azotynów i azotanów.
Rozporządzenie Ministra Zdrowia z dnia 27.12.2000 r. Wykaz dopuszczalnych ilości zanieczyszczeń w środkach spożywczych i używkach oraz substancjach dodatkowych. 2001. Dz. U. 9, Zał. 4, 5.02.2001 r., poz. 72.
Rutkowska G., 1999. Badania zawartości azotanów i azotynów w warzywach uprawianych konwencjonalnie i ekologicznie. Przem. Spoż. 6, 47-49.
Szponar L., Mieleszko T., Kierzkowska E., 1981. Azotany i azotyny w produktach spożywczych oraz poddanych obróbce wstępnej i termicznej. Rocz. PZH 32 (2), 129-135.
Wartanowicz M., 2003. Witaminy. In: Żywienie człowieka. T. 1. Eds. J. Gawęcki i L. Hryniewski. PWN Warszawa, 241-280.
Wawrzyniak A., Gronowska-Senger A., Górecka D., 1999. Ocena pobrania azotanów i azotynów z żywnością w gospodarstwach domowych w Polsce w latach 1990-1995. Rocz. PZH 50 (3), 269-287.

OCENA ZAWARTOŚCI NIEKTÓRYCH SKŁADNIKÓW W MINIMALNIE PRZETWORZONYCH SURÓWKACH WARZYWNYCH POCHODZĄCYCH Z SIECI HANDLOWEJ

Streszczenie. Materiałem badawczym było 14 rodzajów gotowych do spożycia surówek warzywnych, zaliczanych do żywności nisko przetworzonej (o 7 dniach trwałości). Ozna-

czano w nich: suchą masę, białko ogółem, cukry ogółem, błonnik surowy, popiół ogólny, kwas askorbinowy oraz azotany i azotyny. W zależności od rodzaju surówki występowały istotne różnice między średnią zawartością poszczególnych składników. Większość badanych surówek (porcja 100 g) mogła zapewnić około 20-40% dziennego zapotrzebowania ludzi dorosłych na witaminę C. Zawartość azotanów wahała się w przedziale 184,9-768,6 mg $NaNO_3 \cdot kg^{-1}$ i można ją określić jako niską do średniowysokiej. W większości prób surówek nie stwierdzono obecności azotynów, a w pozostałych ich ilość była niska i wynosiła 0,20-0,83 mg $NaNO_2 \cdot kg^{-1}$.

Słowa kluczowe: surówki warzywne, minimalne przetwarzanie, składniki chemiczne

Accepted for print – Zaakceptowano do druku: 28.04.2004

***For citation – Do cytowania**: Wójcik-Stopczyńska B., Grzeszczuk M., Jakubowska B., 2004. The estimation of some constituents contents in minimally processed vegetable salads purchased in the retail network. Acta Sci. Pol., Technol. Aliment. 3(1), 157-165.*