

## ANALYSIS OF CARROT JUICES ASSORTMENT FROM THE ORGANIC AND CONVENTIONAL PRODUCTION AND CONSUMER SENSORY EVALUATION OF SELECTED PRODUCTS

### Summary

*The level of consumer interest in a healthy lifestyle and the quality of food increased in recent years. At the same time, the increase of interest in healthy lifestyle and environmental attitudes lead to consumer's search for the organic food as an alternative to conventional mass-produced food. These prerequisites prompt organic producers to look for new solutions and bring an increasingly broad range of products, including fruit juices, fruit and vegetables juices, and vegetables juices to the market. The aim of this study was to analyse the assortment of carrot juices from organic and conventional production in Warsaw stores, and to carry out consumer sensory evaluation of selected products. It has been shown that there is a large diversity of carrot juice assortment in the Polish market. The market is strongly dominated by juices from conventional production, which is associated with large scale advertising campaigns. Consumer sensory evaluation of selected organic and conventional juices showed significantly higher sensory notes in terms of taste, smell, colour, texture and overall palatability for conventional products. In order to improve the acceptance and consumption of organic juices, actions aimed at increase of consumer awareness, allowing for a conscious choice of high quality products, are necessary. Moreover, organic producers should improve the sensory quality of their products, which may be reflected in an increase of interest from the buyers' site.*

**Key words:** organic and conventional food, carrot juices, assortment, consumer evaluation

## ANALIZA ASORTYMENTU SOKÓW Z MARCHWI Z PRODUKCJI EKOLOGICZNEJ I KONWENCJONALNEJ ORAZ KONSUMENCKA OCENA SENSORYCZNA WYBRANYCH PRODUKTÓW

### Streszczenie

*Na przestrzeni ostatnich lat rośnie poziom zainteresowania zdrowym stylem życia i żywnością, która ma pozytywny wpływ na ludzki organizm. Jednocześnie wzrost ten oraz promowanie postaw proekologicznych skłania konsumentów w kierunku żywności ekologicznej, jako alternatywy dla masowo produkowanej żywności konwencjonalnej. Przestanki te powodują, że producenci żywności ekologicznej poszukują nowych rozwiązań, wprowadzając na rynek coraz szerszy asortyment produktów, w tym soków owocowych, owocowo-warzywnych i warzywnych. Celem niniejszej pracy było podjęcie badań z zakresu analizy rynku soków z marchwi pochodzącej z produkcji ekologicznej i konwencjonalnej w sklepach warszawskich, jak również przeprowadzenie konsumenckiej analizy sensorycznej wybranych produktów. Wykazano, że na polskim rynku istnieje duża różnorodność asortymentowa soków marchwiowych. Szczególnie popularne są te z produkcji konwencjonalnej, co związane jest z dużą dostępnością oraz aktywnością reklamową produkujących je firm. Analiza konsumencka wybranych pięciu par soków ekologicznych i konwencjonalnych wykazała, że istotnie wyższymi notami sensorycznymi w zakresie smaku, zapachu, barwy, konsystencji i pożądalności ogólnej odznaczały się soki z produkcji konwencjonalnej. W celu zwiększenia spożycia soków ekologicznych niezbędne są działania mające na celu wzrost świadomości konsumentów w zakresie żywności ekologicznej, co pozwoli na świadomy wybór wysokiej jakości produktów. Niezbędna jest również wymiana opinii konsumenckich z producentami soków ekologicznych w celu poprawy jakości sensorycznej ich produktów, co może przelżyć się na wzrost zainteresowania ze strony odbiorców.*

**Słowa kluczowe:** żywność ekologiczna i konwencjonalna, soki marchwiowe, asortyment, ocena konsumencka

### 1. Introduction

Fresh vegetables and their preserves are a substantial component of everyday diet, mainly considering content of dietary fibre, vitamins, mineral components, antioxidants and organic acids.

Regrettably, the consumption of vegetables and fruits in Poland is too low and is affected by high seasonal fluctuations. However, it can be observed, that interest in vegetable as well as fruit juices and drinks, that may complement consumption of fresh products, is increasing [1, 2]. Juices are a valuable source of vitamins, mineral components and antioxidants. In clinical research, the fact of better effi-

ciency and assimilability of natural antioxidants contained in juices was confirmed, in comparison to oxidants coming from supplementation. At the same time, consumers more and more often choose purée juices, with a large popularity of a carrot juice amongst them, which is rich in mineral components, carotenoids, vitamins and fibre. Thus, they can be treated as a good source of natural bioactive components in diet [1, 3].

An increasing risk of occurrence of chronic, non-infectious illnesses, such as: hypertension, atherosclerosis, obesity, diabetes, but most of all cancer, brings society to take steps towards rational nutrition, using high quality products, including those coming from an organic agricul-

ture. Aware consumers more and more often search for food, whose production process guarantees high quality of product, what is confirmed by appropriate certificates. In consumers' opinion, organic food complies with these criteria. Due to a control on every stage of production and distribution chain, organic vegetables and fruits are characterised by almost complete lack of remains of chemicals used in agricultural production and higher content of nutritional and bioactive ingredients [4, 5, 6, 7]. Because of this, in opinion of many consumers, organic food is healthier and safer. Moreover, it is characterised by higher sensory values [8]. It makes organic food producers look for new solutions and introduce wider and wider range of products to the market [9].

Taking into account above conditions, it was considered as proper to undertake research in an area of analysing the market of organic and conventional carrot juices in retail shops, as well as performing consumer sensory analysis of selected products.

## 2. Material and research methods

### 2.1. Analysis of carrot juice organic and conventional assortment

Researched material consisted of carrot juice assortment from selected food stores. We can divide them into 3 categories: supermarkets, organic food shops and internet shops. For evaluation of carrot juice assortment, a special questionnaire containing specified analysis markers was created. Among other things it consisted of: shop's name, product's and producer's name and also a name of certifying unit (in case of organic products).

When evaluating the assortment of carrot juices in specialized shops offering organic products, following shops were taken into account: Organic Farma Zdrowia, Żywność Ekologiczna, Wasz Sklep, Smak Natury, Heliantus, MyEcoLife, Zielony Żuczek and Free Delikatesy. In case of conventional shops, large stores were selected: Carrefour, Real, Tesco, E.Leclerc, Piotr I Paweł and MarcPol. In analysis of internet shops offer, taking into account avail-

ability of carrot juices, following shops were selected: sklep.biosfera24.pl, eko-kraina.com.pl, zielonyzuczek.pl, ekosmakosz.pl, freedelikatesy.pl, ekolandia24.pl, green-family.pl, biovert.pl, smaknatury.pl, terpentio.pl. Vegetable juices, as well as mixed fruit-vegetable and vegetable-fruit juices containing carrot, were also classified as carrot juice assortment.

### 2.2. Consumer sensory rating of selected organic and conventional carrot juices

The material for sensory studies consisted of 5 conventional carrot juices and 5 certified organic carrot juices. Juices were bought in conventional food stores and specialistic organic food shops. For research process, juices of 5 taste options were obtained, most common in conventional shops as well as organic shops offers (table 1).

50 people took part in sensory rating of carrot juices. Semi-consumer panel consisted of students ageing from 20 to 25 years old. Evaluation of selected juices in terms of characteristics: smell, colour, consistency, taste, overall palatability was conducted using linear scaling method in order to express quantitative difference of quality [10]. Analysis was performed using 9-grade graphic scale, with border marks: undesirable (I dislike it were much) and very desirable (I like it very much). Every person taking part in the study received 10 coded test samples of previously bought juices (5 of organic juices and 5 of conventional juices in same taste options) and rating form.

### 2.3. Statistical analysis of results

Statistical analysis was created using STATOGRAPHICS 5.1 application. Single-factor analysis of ANOVA variation was applied, using parametric Tukey's test ( $\alpha = 0,05$ ). Studied factor included carrot juice's origin (of conventional and organic production), considering comparison of juices samples of the same taste option (organic as well as conventional).

Table 1. Characteristic of juices selected for sensory studies

Tab. 1. Charakterystyka soków wybranych do badań sensorycznych

Juice taste option	Characteristics of organic juices	Characteristics of conventional juices
carrot – apple	pasteurized, without sugar, 70% squeezed apple juice, 30% carrot juice	pasteurized, without sugar, 70% squeezed apple juice, 30% carrot juice, enriched with vitamin C
carrot	pasteurized, without sugar, 96% carrot juice, 4% lemon juice	pasteurized, enriched with vitamins; ingredients: 45% carrot purée, water, sugar and/or Glucose-Fructose syrup, acidity regulator – citric acid and vitamins: C and E
carrot – apple – peach	pasteurized, without sugar; ingredients: water, concentrated organic apple juice 59%, organic carrot purée 31%, organic peach purée 10%, natural peach aroma	pasteurized, made partially of concentrated juices; ingredients: juices made of juice concentrates and purées: carrot 35%, apple 5%, peach 4%, water, Glucose-Fructose syrup, acidity regulators– citric acid and malic acid, vitamin C, aromas
carrot – apple – banana	pasteurized, made of concentrated juice and purées, without sugar; ingredients: apple juice made of juice concentrate, without sugar; ingredients: apple juice made of juice concentrate 59%, carrot purée 30%, banana purée	pasteurized, produced partially with juice concentrates, without sugar; ingredients: juices made of concentrates and purées: grapes, carrots 22%, apples 18%, bananas 18%
carrot – strawberry – apple	pasteurized, without sugar; ingredients: apple juice made of juice concentrate 59%, carrot purée 38%, raspberry purée 3%, natural aroma	pasteurized, enriched with vitamin C; ingredients: water, Mazurska carrot purée 35%, raspberry purée 4% and apple purée 3%, Glucose-Fructose syrup, acidity regulator – citric acid, vitamin C, aroma

Source: Own research based on information from juices' labels

Taste variant was a studied factor in comparison of overall palatability in a group of organic or conventional juices. A value of  $p$  factor was given in tables. N.s. symbol means lack of statistical relevancy with  $\alpha \leq 0,05$ . Standard deviations that are shown on graphs, were also counted for obtained results.

### 3. Results and discussion

#### 3.1. Assortment of carrot juices in conventional and organic food shops

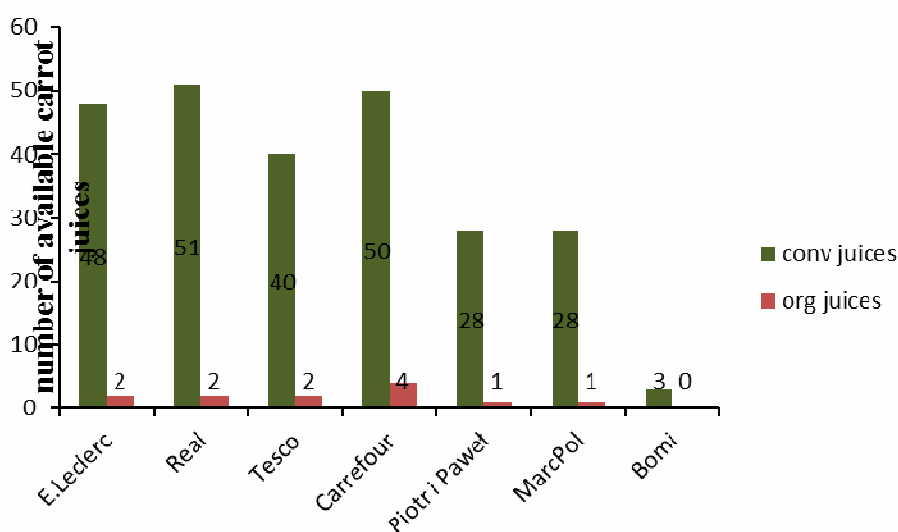
In the opinion of research scientists, Polish people consume the most juices out of Eastern Europe countries [11]. Mostly preferred is an orange juice (24,6%), followed by vegetable juices, including carrot juices (22,2%), and then apple juices (16,4%). A high consumption of carrot based juices is the characteristic differentiating Polish market from other European markets [11, 12, 13].

On Fig. 1 there was presented a number of organic and

conventional carrot juices in assortment of selected supermarkets in Warsaw. The largest assortment of conventional products belonged to Real and Carrefour hypermarkets, the least to Bomi supermarkets. In case of organic juices, they were not largely represented in researched shops, ranging from 1 to 4 products of this category. In the assortment of Bomi shop there were not any organic quality carrot juice.

Amongst eight stationary organic shops, only half of them offered carrot juices. The largest number of these products was available in Free Delikatesy, which offered five different products. Smak Natury placed itself on the second position, having three carrot juices in its offer.

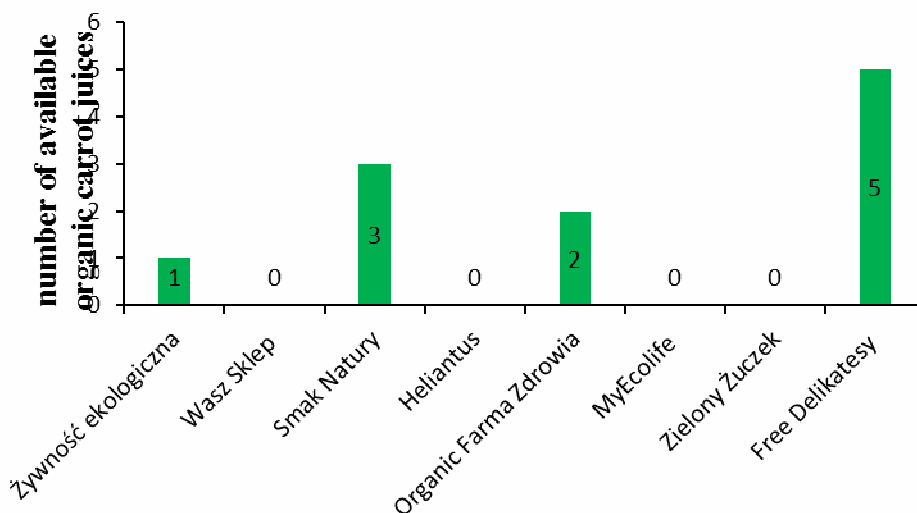
The assortment analysis conducted in ten internet organic food shops, taking availability of organic carrot juices into account (Fig. 3), has shown, that they could be bought in eight of examined shops. Most of these products, similarly like in the case of stationary shops, was offered by Free Delikatesy internet shop. Ekolandia24 and Terpento did not offer any carrot juices.



Source: Authors' own research

Fig. 1. The number of organic and conventional carrot juices available in selected conventional supermarkets

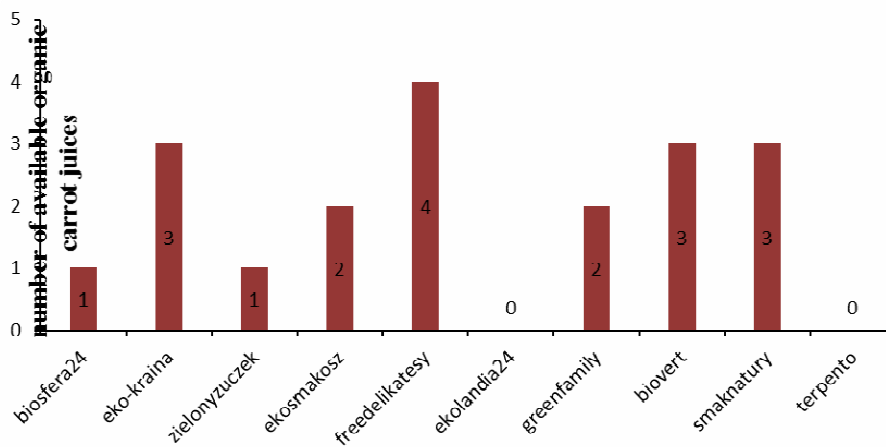
Rys. 1. Liczba soków marchwiowych z produkcji ekologicznej i konwencjonalnej dostępnych w wybranych wielkopowierzchniowych sklepach konwencjonalnych



Source: Authors' own research

Fig. 2. The number of organic carrot juices available in selected stationary organic food shops

Rys. 2. Liczba soków marchwiowych z produkcji ekologicznej dostępnych w wybranych stacjonarnych sklepach z żywnością ekologiczną



Source: Authors' own research

Fig. 3. The number of organic carrot juices available in selected internet organic food shops

Rys. 3. Liczba soków marchwiowych z produkcji ekologicznej dostępnych w wybranych internetowych sklepach z żywnością ekologiczną

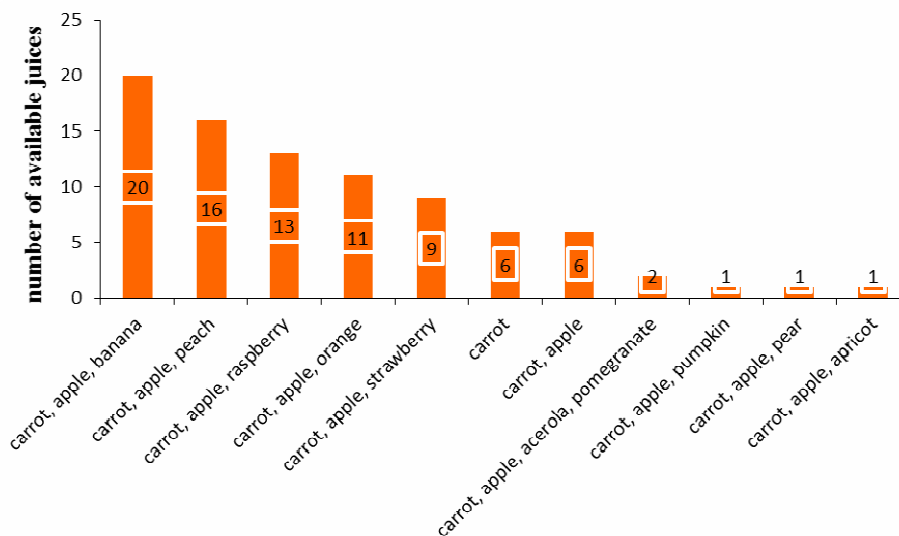
Performed organic juices market analysis demonstrated, that they can be obtained either in organic or conventional food shops. Unfortunately, organic products range is not diversified enough, and consequently, consumer has not much choice comparing to conventional products assortment. Organic products are also less available. Carrot juices were not present in all shops' offers. Żakowska-Biemans [14] stated in her own research, that products of Polish origin significantly increase their share in the organic products market, but the domestic organic products market is not well developed yet. Author also determined reasons that prevent people from buying organic food. As a main barrier, consumers indicated lack of knowledge about labelling of organic products. High prices and no information about where to buy organic products are other reasons for small interest in organic food.

The most common taste variants of carrot juices are: carrot-apple-banana and carrot-apple-peach (Fig. 4). On the other hand, the least popular variants are: carrot-apple-pumpkin, carrot-apple-apricot and carrot-apple-pear.

The most frequently offered conventional juices in examined shops were products of following brands: Tymbark, Hortex, Fortuna and Nestle, whose combined share was more than 76% of whole carrot juices assortment. Out of

Tymbark's juices, Kubaś and Kubaś Go juices dominated assortment in different taste variants and miscellaneous packaging of various capacities (19 products). In case of Hortex, the most popular were Witaminka juices (16 products), Fortuna – Karotka (10 products) and Nestle – Bobo Fruit and Bobo Fruit Junior (10 products). Symbio turned out to dominate organic juices market, offering juices in three taste variants (54,8%) and HIPP, offering two taste variants of carrot juices (23,8%) (Fig. 6).

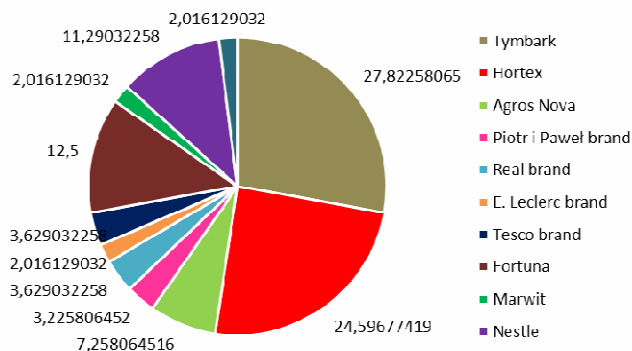
Carrot juice market analysis, conducted in own research, mostly reaffirmed the attributes of Polish juice market, quoted by Pawlak [12]. According to the author, Polish juice market is characterized by domination of Polish brands both in consumers perception and on shelves. Additionally, 50% of market shares belongs to three major producers. The most recognizable brands are: Maspex (Tymbark- MWS Sp. z o.o. S.K.A.), Hortex Holding S.A. and Agros Nova Sp. z o.o. The essential attributes of Polish market are also increasing role of discount shops and their products as well as large share of private labels in juices market [12]. It is convergent with own research, because private labelled products appeared on shelves. Most of carrot juices was produced for Tesco and Real hypermarkets (Fig. 5).



Source: Authors' own research

Fig. 4. Taste variants of carrot juices that are most frequently selected by producers

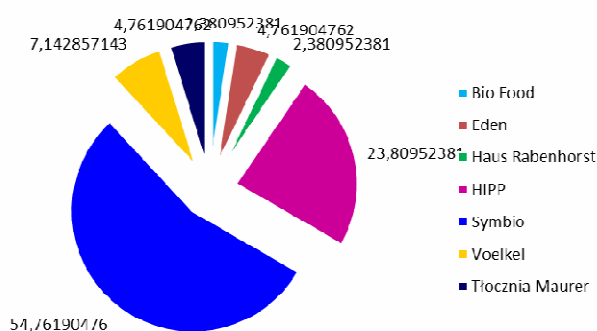
Rys. 4. Najczęściej wybierane przez producentów warianty smakowe soków z marchwi



Source: Authors' own research

Fig. 5. Assortment distribution of brands, according to carrot juices, available in conventional shops [%]

Rys. 5. Podział asortymentu ze względu na markę soków marchwiowych dostępnych w sklepach konwencjonalnych [%]



Source: Authors' own research

Fig. 6. Assortment distribution of brands, according to carrot juices, available in stationary and internet organic shops [%]

Rys. 6. Podział asortymentu ze względu na markę soków marchwiowych dostępnych w stacjonarnych i internetowych sklepach z żywnością ekologiczną

### 3.2. Consumer sensory evaluation of selected organic and conventional carrot juices

The results of carried out consumer sensory evaluation show, that averagely, organic juices were rated significantly lower, when compared to conventional juices, in the range of all studied parameters (Tab. 2). It affected most of taste variants. The least different results were shown in smell evaluation. In case of this parameter consumers did not see differences between organic and conventional juices in following taste variants: 1 (carrot-apple), 2 (carrot), 3 (carrot-apple-banana). In case of variants: 4 (carrot-apple-peach) and 5 (carrot-apple-strawberry) conventional juices were rated higher than organic ones. Consumers also did not notice colour differences of pure-carrot juices between organic and conventional ones. In case of all the other parameters, all taste variants achieved higher notes in conventional option. One of possibilities causing lower consumer rating of organic juices, may be occurrence of bitter and spicy taste in raw material. These two are sensory attributes commonly associated with less wanted taste, smell and overall carrot quality. Spicy taste is an effect of large terpenes content, which are created during plant's growth. Their presence in moderate amount is associated with characteristic carrot aroma, whereas in higher amount is responsible for occurrence of so called "other aftertaste". Among

others, falcarinol is responsible for a bitter taste. It is a derivative of di-caffeic and isochlorogenic acid, whose higher synthesis may be, among other things, answer to the stress resulting from pest attacks. Organic carrot is highly vulnerable to pest attacks compared to conventional carrot [15].

Regrettably, in literature there are not many reports, concerning consumer studies of organic and conventional carrot juices. Malik and Krukowska [16] conducted comparative sensory evaluation of conventional and organic carrot juices. In terms of colour, taste, smell and texture, the highest values were achieved by conventional juices: Witaminka, Kubuś and Karotka. The lowest notes were given to organic products, that being reflected in this study. Similar studies were carried out by Dobrowolska and Tuszyński [17], who researched preferences concerning consumption of carrot juices among secondary school students.

That research indicates, that 78,1% of tested students consumed carrot juices, mostly choosing conventional juices. It comes out, that consumers preferred juices enriched by macro- and microelements and vitamins, with short terms. Among the least preferred products, where these, which could contain genetically modified ingredients. In studies of fresh and stored organic and conventional carrot [18], higher consumer rating in an area of carrot-typical and sweet taste as well as overall quality, was achieved by organic raw material. Other evaluation studies [19] concerned intensity of sweet taste, acidity and general acceptance of organic and conventional grapefruit juices. There was stated, that conventional juices were less bitter and less acrid, thereby more accepted by consumers. The results of orange juice studies [19] have shown lack of differences in consumer evaluation between organic and conventional juices in an area of smell, colour, consistency and overall quality. Only the taste of conventional juices was rated as significantly sweeter in comparison to organic ones. Lack of evident differences was ascertained also in sensory evaluation of organic and conventional beetroot juices. In this study there were only slightly higher values of smell, colour, taste and overall palatability towards organic juices. Consistency was the only factor rated relevantly higher in favour of organic juices, compared to conventional ones [9].

### 4. Conclusions

1. There is a large assortment diversity of carrot juices on the Polish food market. Conventional juices are particularly popular in comparison to the organic ones. Taste variants selected most frequently by producers are: carrot-apple-banana and carrot-apple-peach.
2. Dominating brands amongst conventional producers of carrot juices are: Tymbark, Hortex, Fortuna and Nestle, and amongst organic producers: Symbio and Hipp. Most frequently offered products on the conventional market turned out to be: Kubuś, Witaminka, Karotka and Bobo Fruit.
3. As a result of conducted consumer sensory analysis, organic carrot juices were rated significantly lower than conventional counterparts in terms of taste, smell, consistency, colour and overall palatability. However, in case of three out of five juices, the differences between organic and conventional products were not significant. This concerned

products in following taste variants: carrot-apple, carrot and carrot-apple-banana.

Tab. 2. The results of consumer sensory evaluation of organic (Org) and conventional (Conv) carrot juices in 5 taste variants: 1 – carrot-apple, 2 – carrot, 3 – carrot-apple-peach, 4 – carrot-apple-banana, 5 – carrot-apple-strawberry; scale 1 – 10 ( $\pm$  standard deviation)

Tab. 2. Wyniki konsumenckiej oceny sensorycznej ekologicznych (Org) i konwencjonalnych soków (Conv) marchwiowych w 5 wariantach smakowych: 1 – marchew-jabłko, 2 – marchew, 3 – jabłko-marchew-brzoskwinia, 4 – marchew-jabłko-banan, 5 – marchew-jabłko-malina; ocena w skali 1 – 10 ( $\pm$  standard deviation)

Tested juices	Odour	Colour	Consistency	Flavour	Overall palatability
Org 1	5.8 $\pm$ 2.2 <sup>a</sup>	5.2 $\pm$ 2.0 <sup>b</sup>	5.0 $\pm$ 2.2 <sup>b</sup>	4.9 $\pm$ 2.5 <sup>b</sup>	4.7 $\pm$ 1.9 <sup>b</sup>
Conv 1	5.4 $\pm$ 2.5 <sup>a</sup>	6.5 $\pm$ 2.1 <sup>a</sup>	6.6 $\pm$ 2.1 <sup>a</sup>	6.1 $\pm$ 2.3 <sup>a</sup>	5.9 $\pm$ 2.0 <sup>a</sup>
Org 2	4.7 $\pm$ 2.2 <sup>a</sup>	6.5 $\pm$ 2.1 <sup>a</sup>	4.6 $\pm$ 2.0 <sup>b</sup>	1.6 $\pm$ 1.3 <sup>b</sup>	2.7 $\pm$ 1.7 <sup>b</sup>
Conv 2	5.6 $\pm$ 2.5 <sup>a</sup>	7.2 $\pm$ 1.8 <sup>a</sup>	6.1 $\pm$ 2.3 <sup>a</sup>	5.4 $\pm$ 2.3 <sup>a</sup>	5.6 $\pm$ 2.0 <sup>a</sup>
Org 3	4.4 $\pm$ 2.5 <sup>b</sup>	3.7 $\pm$ 2.1 <sup>b</sup>	5.9 $\pm$ 1.8 <sup>b</sup>	5.3 $\pm$ 2.5 <sup>b</sup>	4.8 $\pm$ 1.9 <sup>b</sup>
Conv 3	7.3 $\pm$ 2.3 <sup>a</sup>	7.5 $\pm$ 1.8 <sup>a</sup>	6.7 $\pm$ 1.9 <sup>a</sup>	7.0 $\pm$ 2.4 <sup>a</sup>	6.9 $\pm$ 2.1 <sup>a</sup>
Org 4	5.2 $\pm$ 2.3 <sup>a</sup>	4.8 $\pm$ 2.3 <sup>b</sup>	5.7 $\pm$ 2.0 <sup>b</sup>	5.0 $\pm$ 2.6 <sup>b</sup>	5.0 $\pm$ 2.2 <sup>b</sup>
Conv 4	6.0 $\pm$ 2.6 <sup>a</sup>	5.8 $\pm$ 2.1 <sup>a</sup>	6.9 $\pm$ 1.9 <sup>a</sup>	7.3 $\pm$ 2.0 <sup>a</sup>	6.9 $\pm$ 1.8 <sup>a</sup>
Org 5	3.8 $\pm$ 2.3 <sup>b</sup>	2.7 $\pm$ 2.0 <sup>b</sup>	4.3 $\pm$ 2.2 <sup>b</sup>	3.4 $\pm$ 2.3 <sup>b</sup>	3.4 $\pm$ 2.0 <sup>b</sup>
Conv 5	7.1 $\pm$ 2.2 <sup>a</sup>	7.4 $\pm$ 1.8 <sup>a</sup>	6.9 $\pm$ 1.7 <sup>a</sup>	6.8 $\pm$ 2.3 <sup>a</sup>	6.8 $\pm$ 2.1 <sup>a</sup>
<b>Average</b>					
Org	4.8 $\pm$ 2.4 <sup>b</sup>	4.6 $\pm$ 2.4 <sup>b</sup>	5.1 $\pm$ 2.2 <sup>b</sup>	4.0 $\pm$ 2.6 <sup>b</sup>	4.1 $\pm$ 2.1 <sup>b</sup>
Conv	6.3 $\pm$ 2.5 <sup>a</sup>	6.9 $\pm$ 2.0 <sup>a</sup>	6.6 $\pm$ 2.0 <sup>a</sup>	6.5 $\pm$ 2.4 <sup>a</sup>	6.4 $\pm$ 2.0 <sup>a</sup>
<b>p-value</b>					
Production system	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Source: Authors' own research

4. In order to increase the consumption of organic juices, some actions are necessary aiming at increase of consumer nutritional awareness. This will allow a conscious choice of high quality products. Analysis of low sensory evaluation of organic carrot juices is also necessary, as well as an exchange of consumer opinion between producers of organic juices to improve sensory quality of their products. This may lead to an increase of customers' interest in organic products.

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