Ingredients of popular fruit teas in Poland

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ABSTRACT

Fruit teas are very popular on the market of food products in many countries, due to their attractive taste and aroma as well as pro-health and medicinal properties. They are also characterized by the great wealth and diversity of composition. The purpose of this study was to analyze selected products based on the information contained on their packaging. The research included the most popular fruit teas widely available on the Polish food market, i.e. raspberry, cranberry and rosehip teas, 82 products in total. It was found that plant raw materials appearing in the tea names often constitute a small percentage of their composition, while hibiscus and apple occur very often and in the large quantities. The analysis of the content of the basic ingredient of raspberry and cranberry teas showed that they are characterized by a large diversity of quality. In addition to products with a relatively high amount of raspberry or cranberry (mean: 43.8 and 27.2%, respectively), there were teas with a very low level of these ingredients (mean: 7.5 and 1.6%). Against this background, rosehip tea has stood out positively. In this category of products, *Rosa* spp. hips, as a widely available plant raw material, most often obtained content above 30-40%.

1. INTRODUCTION

The great popularity of fruit teas results from their attractive aroma and taste as well as health-promoting properties. Fruits, flowers, leaves and other plant raw materials being ingredients of fruit teas are an important source of phenolic compounds such as phenolic acids (hydroxybenzoic and hydroxycinnamic acids, and their derivatives), flavonols, flavanols, anthocyanins, and tannins as well as vitamins and minerals, including vitamin C. Especially berry phenolics represent a diverse group of active constituents with a high antioxidant potential [1-5].

Our earlier investigations indicated that fruit teas are characterized by a rich composition. In 187 products widely available in the retail chains in Poland, about 60 different plant raw materials were detected. The average number of ingredients in fruit teas was 7.1 (from 1 to even 12), including plant raw materials: 5.5 (1-11), and various types of additives: 1.5 (from 0 to 4). Raspberry, cranberry and rosehip teas belonged to the most numerous products in this group [6].

Fruits of red raspberry (*Rubus idaeus*), cranberry (*Oxycoccus macrocarpos* and *O. palustris*) as

well as wild rose species (*Rosa canina* and other similar species) are widely used not only in the food industry, but also in phytotherapy. Antioxidant, anti-inflammatory, antimicrobial, and anticancer properties of raspberry are associated with a high content of polyphenolic compounds, mainly anthocyanins and ellagitannins [7, 8]. Cranberry is often utilized in the treatment of urinary tract infections, but it can be used in the prevention of cardiovascular and gastric ulcer diseases [9, 10]. In turn, rose hips are mainly known as a rich source of vitamin C, lycopene, lutein, zeaxanthin, and other carotenoids. Due to the content of an anti-inflammatory galactolipid GOPO, this plant has proven useful in the treatment of osteoarthritis and rheumatoid arthritis [11, 12].

The health benefits of fruit tea drinking strongly depend on the quality and composition of the plant raw materials that were used to prepare these mixtures. The large number of products on the food market makes it difficult for consumers to choose the right ones. Unfortunately, our preliminary studies have shown that the names of many fruit teas do not describe their composition accurately [6]. The value of these products is also influenced by the presence of food additives: flavourings, acidity regulators, and sweeteners [6, 13]. Therefore, in the present work we decided to analyze this issue in detail.

The aim of the study was to describe the composition of the most popular fruit teas available on the Polish food market: raspberry, cranberry and rosehip teas. The paper presents the list of plant raw materials and food additives given by the producers as well as the percentage share of some ingredients.

2. MATERIALS AND METHODS

In the study, 82 fruit and fruit-herbal teas widely available on the Polish food market in the years 2015-2017 were used. The research included raspberry, cranberry and rosehip teas sold in the grocery stores and supermarkets, which are the most popular in this group of products. For analysis, bagged teas with raspberry, cranberry or rose on the first place of the name were selected. Products available only in pharmacies and/or herbal stores were excluded from investigations. We did not take into consideration flavoured or fruit-herbal teas

containing *Camellia sinensis*, *Aspalathus linearis* (rooibos) or *Ilex paraguariensis* (yerba mate). All data about the products, in particular regarding their name and composition, came from the information on the packaging.

Incomplete data of producers concerning on the percentage share of plant raw materials and food additives in the mixtures did not allow precise description of the quantitative composition of fruit teas. Therefore, the attention was focused on the qualitative analysis of the composition of individual products and the frequency of occurrence of the different components. In the investigations, the information given on the labels on the percentage content of plant raw materials appearing in the names of fruit teas was also used. In addition, it was assumed that the order of occurrence of the individual plant materials in the list of ingredients fairly well reflects their relative quantitative contribution in a given mixtures, what was confirmed in the analysis of the collected data. Hence, the plant raw materials, which occurred from the first to the third position in the list of ingredients of fruit teas were considered as the main (dominating) components of these products [6].

Some difficulty in research resulted from the inconsistent and sometimes ambiguous way of description of the names of plant raw materials by individual producers. It was helpful comparing the composition of different teas, analysis of the pictures on the packaging, and sometimes the information from the manufacturer. In the prepared ingredient list of the fruit teas, the possibility of obtaining a plant raw material from a larger number of species was marked. The diagnosis of the plant raw materials was based on the textbooks of pharmacognosy, plant dictionaries and other similar works [14-22]. In this article, the names accepted in the herbal literature such as hibiscus flower, linden flower, raspberry fruit, rose fruit, etc. were used [23-25].

This work presents a list of plants appearing in the names of the analyzed fruit teas, giving their number of occurrences on the first, second and third place in the name, respectively and their average percentage content in the composition of these teas (Table 1). Next, the full composition of the mixtures was investigated, with division into raspberry, cranberry and rosehip teas, calculating the relative

frequency of occurrence of the individual plant raw materials (Table 2) and food additives (Table 3). For each type of tea, the bar graph showing the differentiation of the percentage content of the basic component: raspberry, cranberry or rosehip was prepared (Figs. 1, 3, 4). The statistical significan-ce of differences (Mann-Whitney U test) between product groups with the high and low amount of these ingredients was also calculated. Due to the largest number of samples (38 products), raspberry teas were analyzed in more detail. Figure 2 shows the number of occurrence of the individual plant raw materials and food additives on the first three places of the ingredient list, separately for raspberry teas with the high and low *R. idaeus* fruit content. For these groups, the statistical significance of differences (Mann-Whitney U test) regarding the number of all ingredients, plant raw materials and food additives was also assessed.

3. RESULTS

Survey of the Polish food market in the years 2015-2017 showed 38 raspberry teas, 24 cranberry teas, and 20 rosehip teas (in total: 82) produced by 20 different companies. They were described on the packaging as fruit (59.8% of cases), fruit-herbal (36.6%) or herbal-fruit (3.7%) teas. In their names, one (45.1% of cases), two (47.6%) or three (7.3%) plants occurred. In all, 23 plant species were found in the names of investigated fruit teas, but these ingredients often have a low percentage share in the mixtures (Table 1). In extreme cases, it was only 1-3% or even below 1%.

Table 1. Plants listed in the names of fruit teas and the mean content of these raw materials.

No.	Plants (raw material)	No. of occurrence in tea names and (mean content)		
		1st place	2nd place	3rd place
1	Raspberry (fruit)	38 (26.6%)	9 (9.7%)	
2	Cranberry (fruit)	24 (18.6%)	4 (6.5%)	1 (2%)
3	Dog rose (fruit, i.e. hip)	20 (46.3%)	2 (13.0%)	
4	Apple (fruit, peel)		4 (18.3%)	
5	Pomegranate (peel, juice, extract)		3 (2.0%)	1 (1%)
6	Strawberry (fruit)		3 (2.0%)	
7	Hibiscus (flower, i.e. calyx)		2 (27.5%)	
8	Linden (flower)		2 (17.5%)	
9	Quince (fruit)		2 (6.1%)	
10	Lemon (peel)		2 (5.4%)	
11	Bilberry (fruit)		2 (1.0%)	
12	Blackcurrant (fruit)		2 (0.3%)	
13	Rosebay willowherb (herb)		1 (25%)	
14	Mullein (flower)		1 (20%)	
15	Ginger (rhizome)		1 (13%)	
16	Lemongrass (herb)		1 (7.7%)	
17	Acerola (fruit)		1 (2.0%)	
18	Blackberry (fruit)		1 (0.5%)	
19	Chili pepper (fruit)		1 (0.4%)	
20	Sour cherry (juice concentrate)		1 (0.4%)	
21	Rhubarb (leaf petiole)			2 (1%)
22	Peppermint (leaf)			1 (9%)
23	Açai (juice concentrate)			1 (0.6%)

Only rosehip teas were characterized by a high mean content of the basic component (46.3%). On the other hand, ingredients rarely mentioned in the tea names such as hibiscus or apple are the permanent component of these products, and they get a share of up to 40-50% or 35%, respectively.

Depending on the type of fruit tea, hibiscus appeared in 79-95% of products and apple in 58-67% (Table 2). Cranberry teas were distinguished by a more frequent presence of chokeberry (46% of cases) and blackcurrant fruits (42%), while for raspberry teas it was elder fruits (32%). In turn, rosehip teas had the lowest total number of plant raw materials (24), but also the smallest constancy of occurrence of flavourings: 55% of cases (Tables 2-3).

**Table 2.** Plant raw materials of raspberry, cranberry and rosehip teas (n=82).

No.	Plants (raw material)	Botanical names	Frequency of occurrence in teas [%]		
			Raspberry tea (n=38)	Cranberry tea (n=24)	Rosehip tea (n=20)
1	Raspberry (fruit)	*Rubus idaeus* L.	100	33	25
2	Cranberry (fruit)	*Oxycoccus macrocarpos* (Aiton) Pursh, *O. palustris* Pers.	11	96	5
3	Dog rose (fruit, i.e. hip)	*Rosa canina* L. and other similar species	50	42	100
4	Hibiscus (flower, i.e. calyx)	*Hibiscus sabdariffa* L.	95	79	95
5	Apple (fruit, peel)	*Malus domestica* Borkh.	58	67	65
6	Chokeberry (fruit)	*Aronia melanocarpa* (Michx.) Elliott	32	46	25
7	Blackcurrant (fruit)	*Ribes nigrum* L.	5	42	10
8	Elder (fruit)	*Sambucus nigra* L.	32	13	15
9	Liquorice (root)	*Glycyrrhiza glabra* L.	26	17	10
10	Blackberry (leaf)	*Rubus fruticosus* L. agg.	21	17	5
11	Hawthorn (fruit)	*Crataegus monogyna* Jacq. and other similar taxa	0	13	0
12	Linden (flower)	*Tilia cordata* Mill., *T. platyphyllos* Scop.	11	4	5
13	Raspberry (leaf)	*Rubus idaeus* L.	11	0	0
14	Sweet blackberry (leaf)	*Rubus suavissimus* S. Lee	5	8	10
15	Peppermint (leaf)	*Mentha x piperita* L.	3	0	10
16	Black hollyhock (flower)	*Alcea rosea* L. var. *nigra*	0	4	10
17	Orange (peel)	*Citrus aurantium* L. ssp. *aurantium*, *C. sinensis* (L.) Osbeck	8	8	0
18	Bilberry (fruit)	*Vaccinium myrtillus* L.	8	4	5
19	Lemon (peel)	*Citrus limon* (L.) Osbeck	8	4	5
20	Chicory (root)	*Cichorium intybus* L.	3	8	5
21	Blackberry (fruit)	*Rubus fruticosus* L. agg.	5	4	5
22	Strawberry (fruit)	*Fragaria x ananassa* Duch.	5	4	5
23	Rowan (fruit)	*Sorbus aucuparia* L.	0	0	5
24	Blackthorn (fruit)	*Prunus spinosa* L.	0	0	5
25	Rhubarb (leaf petiole)	*Rheum rhabarbarum* L.	0	4	5
26	Nettle (leaf)	*Urtica dioica* L.	0	0	5

No.	Plants (raw material)	Botanical names	Frequency of occurrence in teas [%]		
			Raspberry tea (*n*=38)	Cranberry tea (*n*=24)	Rosehip tea (*n*=20)
27	Ginger (rhizome)	*Zingiber officinale* Roscoe	3	4	0
28	Grapefruit (peel)	*Citrus paradisi* Macfad.	0	4	0
29	Lemongrass (herb)	*Cymbopogon citratus* (DC.) Stapf.	3	4	0
30	Quince (fruit)	*Cydonia oblonga* Mill.	5	0	0
31	Pomegranate (peel)	*Punica granatum* L.	3	4	0
32	Chamomile (flower)	*Matricaria chamomilla* L.	0	4	0
33	Strawberry (leaf)	*Fragaria x ananassa* Duch.	0	4	0
34	Red currant (fruit)	*Ribes rubrum* L.	3	8	0
35	Elder (flower)	*Sambucus nigra* L.	3	0	0
36	Mullein (flower)	*Verbascum densiflorum* Bertol., *V. phlomoides* L.	3	0	0
37	Acerola (fruit)	*Malpighia glabra* L.	3	0	0
38	Cornflower (petals)	*Centaurea cyanus* L.	3	0	0
39	Rose (petals)	*Rosa* spp.	0	0	5
40	Rosebay willowherb (herb)	*Epilobium angustifolium* L.	0	4	0
41	Chili pepper (fruit)	*Capsicum annuum* L.	3	0	0
42	Ginseng (root)	*Panax ginseng* C.A. Meyer, *P. quinquefolius* L.	0	4	0
43	Sour cherry (stems)	*Prunus cerasus* L.	0	4	0

Table 3. Food additives in raspberry, cranberry and rosehip teas (*n*=82).

| No.	Food additives	Frequency of occurrence in teas [%]		
		Raspberry tea (*n*=38)	Cranberry tea (*n*=24)	Rosehip tea (*n*=20)
1	Flavourings	79	71	45
2	Natural flavourings	16	8	0
3	Raspberry flavour	3	4	5
4	Strawberry flavour	0	0	5
5	Cranberry flavour	0	4	0
6	Citric acid (acidity regulator)	29	46	30
7	Malic acid (acidity regulator)	5	0	10
8	Chokeberry (juice concentrate)	5	17	10
9	Sour cherry (juice concentrate)	3	0	0
10	Açai (juice concentrate)	3	0	0
11	Raspberry (juice concentrate, dried juice)	5	0	5
12	Cranberry (juice concentrate, juice granules)	0	8	0
13	Pomegranate (extract, juice granules)	3	4	0
14	Maltodextrin	5	4	10

Detailed analysis of the composition of raspberry teas indicates two separate groups of products with different quality levels. The first group is characterized by a very low content of the basic ingredient, sometimes in the range of 0.1-0.6% and with mean value of 7.5%. In the second group, average content of raspberry was 43.8% with the highest value of 60% (Fig. 1).
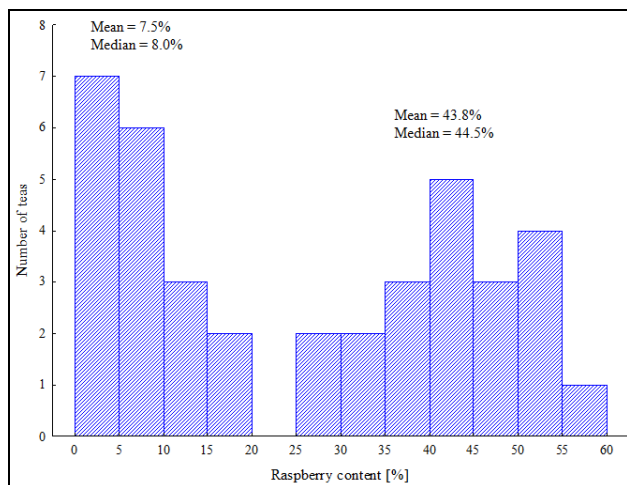
Figure 1. Content of the basic component (*Rubus idaeus* fruit) in raspberry teas (*n*=38).
Mann-Whitney U test for differences between two groups of products: with a low and high content of raspberry: *p*<0.001.

In the case of teas with a low amount of *R. idaeus* fruits, hibiscus and apple were the main component of the mixtures, and they appeared the most frequently on the first and second place in the list of ingredients, respectively. In addition, statistically significant more components, including food additives, were present in these products (Fig. 2). Similar differentiation in the product quality was also observed for the other fruit teas. The average content of the basic ingredient of cranberry tea, depending on the product group, was 1.6% and 27.2% (Fig. 3). In turn, for rosehip teas, it was 8.3% and 50.6%, respectively. However, the products with a high rosehip content were definitely dominant (Fig. 4).
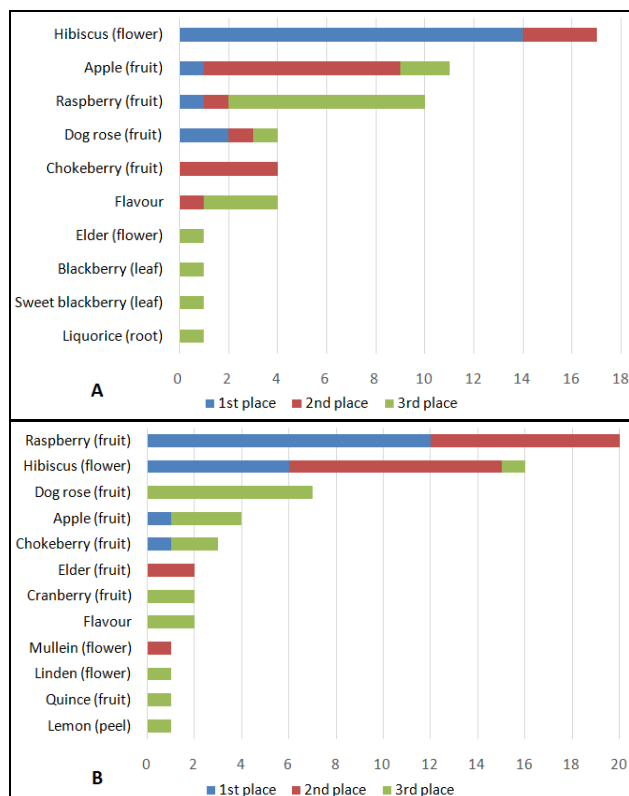
Figure 2. The number of occurrence of the individual plant raw materials and food additives on the first three places of the ingredient list of raspberry teas (*n*=38).
A) products with a low content of raspberry (0.1-20%, *n*=18); B) with a high content of raspberry (26-60%, *n*=20; compare with Fig. 1).
Mann-Whitney U test for differences between two groups of products in terms of total number of tea ingredients: *p*<0.01 (Mean=7.9 and 5.75 for A and B, respectively), food additives: *p*=0.01 (Mean=1.9 and 1.25) and plant raw materials: *p*=0.015 (Mean=6.0 and 4.5).
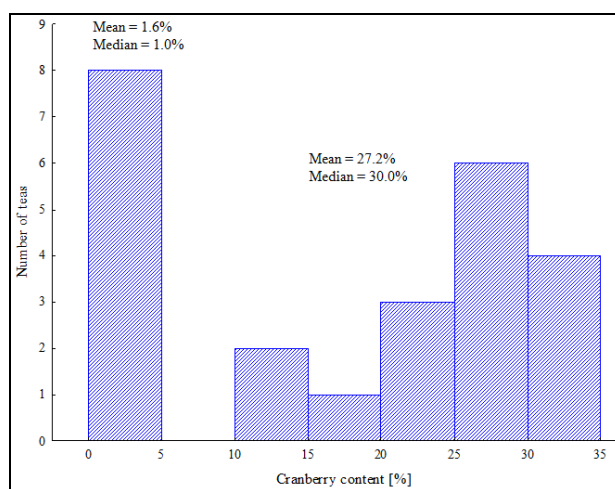
Figure 3. Content of the basic component (*Oxycoccus* spp. fruit) in cranberry teas (*n*=24).
Mann-Whitney U test for differences between two groups of products: with a low and high content of cranberry: *p*<0.001.
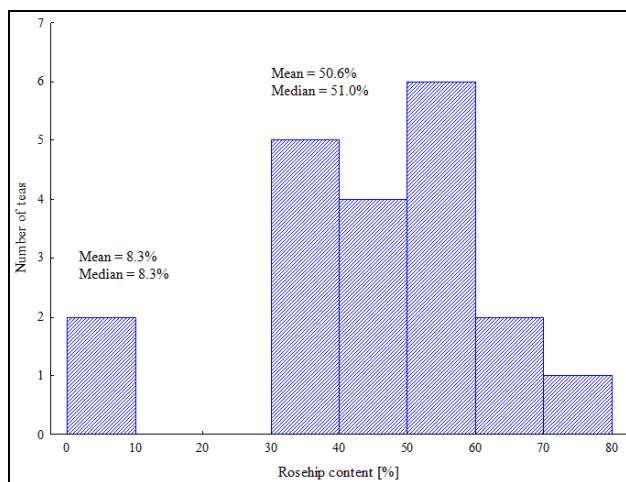
Figure 4. Content of the basic component (*Rosa* spp.) in rosehip teas (*n*=20).

4. DISCUSSION AND CONCLUSION

The survey of the Polish food market pointed to clear consumer preferences in the field of fruit teas. Considering the number of available products, it can be assumed that raspberry, cranberry and rosehip teas are most frequently chosen. This is due to the well-known pro-health and medicinal properties of these plants [7, 10, 12]. Attention was drawn to the large number of plant species occurring in the names of teas, next to raspberry, cranberry and rosehip (Table 1). Certainly, it results in increased interest in the products on the market. Importantly, the name and packaging of fruit teas are sometimes misleading, because the mentioned and illustrated plant raw materials often occur in the small quantities. On the other hand, hibiscus, apple and rosehip very often appear in large quantities and in various types of teas due to the low price of the raw material (apple and rosehip) or properties improving the taste and color of infusions (hibiscus) [6]. Unfortunately, food additives, especially flavourings, belong to the constant ingredients of fruit teas, too. Interestingly, the occurrence frequency of these components is clearly lower in the case of rosehip tea (Table 3).

Some plant raw materials present in fruit teas can be harvested from the different species [e.g. 18], what undoubtedly affects the composition and level of active compounds. Rose hips mainly collected from *Rosa canina*, but also from other wild growing species that exhibit significant phytochemical variability are a classic example of such a situation [26].

Unfortunately, there is no precise data on the labels concerning plant raw materials, especially full botanical names of taxa.

The analysis of the content of the basic ingredient of raspberry and cranberry teas showed that these products are characterized by a high variation in quality (Figs. 1, 3), which results from the high price of the discussed plant raw material. In addition to products with a relatively high amount of raspberry or cranberry fruits (mean: 43.8 and 27.2%, respectively), there were teas with a very low level of these ingredients (mean: 7.5 and 1.6%). Against this background, rosehip tea has stood out positively. In this product category, *Rosa* spp. hips, as a widely available raw material, most often obtained content above 30-40% (Fig. 4).

AUTHORS' CONTRIBUTION

AA: study design, data interpretation, preparation of manuscript; AF: preparation of tables and figures, literature analysis; TMK: preparation of manuscript, literature analysis. The final manuscript has been approved by all authors.

TRANSPARENCY DECLARATION

The authors declare that they have no conflict of interest.

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