

# **TOCOPHEROL AND TOCOTRIENOL CONTENTS IN THE SEA BUCKTHORN BERRY BEVERAGES IN BALTIC COUNTRIES: IMPACT OF THE CULTIVAR**

**Pawel Gornas, Inga Mišina, Inta Krasnova, Dalija Segliņa**

**EuroWorks, 25.05.2021.**

# Content of the presentation

- ❑ Introduction
- ❑ Material and methods
- ❑ Results
- ❑ Recommendations for manufacturers

# Introduction - sea buckthorn benefit

- ❑ Excellent source of polyunsaturated fatty acids;
- ❑ Cardio-protective effect;
- ❑ Boost the immune system;
- ❑ Help reduce symptoms of dry eye;
- ❑ Improve digestion;
- ❑ Liver and pancreas support;
- ❑ Fight depression;
- ❑ Support healthy hormones;
- ❑ .....

Google search results for "sea buckthorn benefit".

**Sea-Buckthorn Oil for beautiful skin**  
• Promotes healing of acne, dermatitis, eczema and burns  
• Treats with Vit. A, B1, D, E, and essential fatty acids  
• Reduces the appearance of wrinkles and age spots  
• Improves elasticity and tone of aging skin  
• Promotes youthful skin texture  
• Fights free radical damage  
• Eliminates small wrinkles  
• Nourishes dry skin  
• Balances oily skin

**10 SKIN BENEFITS OF SEA BUCKTHORN OIL**  
- powerful anti-aging properties  
- excellent for dry skin  
- reduces inflammation  
- heals wounds  
- repairs damaged skin  
- and more!

**6 BENEFITS OF SEA BUCKTHORN**  
1. Source of omega 3, 6, 7 & 9 fatty acids  
2. Neutralizes free radicals in the body  
3. Nourishes skin from the inside out  
4. Extremely high in vitamin C  
5. Improves mental clarity  
6. Supports healthy digestion

**10 HEALTH BENEFITS OF SEABUCKTHORN**  
1. High Inducer Symptom of Dry Eye  
2. Cardio-Protective Effects  
3. Boost The Immune System  
4. Fight Depression  
5. Excellent Source of Omega-7 Fatty Acids  
6. Improve Digestion  
7. Moisturize Skin and Scalp  
8. Support Healthy Hormones  
9. Reduce Inflammation  
10. Liver and Pancreas Support

**Sea Buckthorn Oil: Anti-oxidant, Anti...**  
chirokelley.com

**Sea Buckthorn**  
Rich with Antioxidant & Vitamin C  
Available format :  
capsule, Softgel & Juice

**SEA BUCKTHORN**  
facts and health benefits  
healthbenefitstimes.com

**SEA BUCKTHORN SEED OIL**  
The "Super Food"  
• A rich source of 7 essential fatty acids  
• Clinically proven to improve skin health  
• High in Vitamin C  
• Contains 10 times more Vitamin E than olive oil  
• A natural skin conditioner  
• A natural skin conditioner  
• A natural skin conditioner

**SEA BUCKTHORN BENEFITS FOR SKIN, HAIR AND HEALTH**  
• Boosts immune system  
• Aids in managing diabetes  
• Protects against gastric diseases  
• Aids in alleviating joint pain and arthritis  
• Aids in maintaining healthy skin and hair  
• Helps to increase uptake of iron and blood circulation  
• Reduces risk of atherosclerosis, heart attacks and strokes

**SEA BUCKTHORN BERRY THE ANTIOXIDANT AMPLIFIER**  
Also known as the "Berry Fruit of the Himalayas", Sea buckthorn berry can relieve stress, and increase levels of your body's most powerful internally made antioxidant, CoQ10, which is 1,000 times more powerful than Vitamin C.

**Sea Buckthorn Oil & Its Amazing Benefits**  
• Soothes and repairs linings of digestive tracts  
• Effective for skin, hair and nails  
• Improves cardiovascular system  
• Regenerates the skin  
• Fights aging  
• Improves liver health  
• Reduces cholesterol  
• Controls blood sugar

**BENEFITS OF SEA BUCKTHORN**  
• Improves vision  
• Reduces inflammation  
• Improves skin health  
• Reduces cholesterol  
• Controls blood sugar

**12 Health Benefits of Sea Buckthorn + ...**  
selfhacked.com

**sea buckthorn (Elaeagnus rhamnoides) (L ...)**  
sciencedirect.com

**Sea Buckthorn**  
What is Sea Buckthorn? SBT ...  
pinterest.com

**Related searches**  
before and after sea buckthorn benefits  
sea buckthorn benefits in hindi  
sea buckthorn benefits for hair

**Seo Buckthorn Berry Oil**  
Bright Red to Orange Color  
Botanical Flavor  
Contains  
Omega 7  
Omegas 6&9  
Typical Use  
Dryness  
Skin Nourishing  
Skin Issues (Like Eczema)  
Scars/ Skin Repair  
Made From  
Sea Buckthorn Berries  
How to Take Sea Buckthorn Oil and its ...  
seabuckwonders.com

**Benefits Of Sea Buckthorn | Uses ...**  
elavitra.com

**Sea Buckthorn, It's Holy ...**  
thegoodmoodco.com

**Why Choose Sea Buckthorn...**  
seabuckwonders.com

**Seabuckthorn Oil**  
Beauty Benefits  
• Contains 10 times more Vitamin E than olive oil  
• Clinically proven to improve skin health  
• High in Vitamin C  
• Contains 10 times more Vitamin E than olive oil  
• A natural skin conditioner  
• A natural skin conditioner  
• A natural skin conditioner

**BENEFITS OF SEA BUCKTHORN OIL FOR THE SKIN**  
• Reduces inflammation  
• Improves skin health  
• Reduces cholesterol  
• Controls blood sugar

**Sea Buckthorn Oil for t...**  
thebestorganicskincare.c...

**Sea Buckthorn Oil Blen...**  
amazon.com

Fatty acids (%)	Seed oil	Pulp oil
...	...	...

# Introduction - Tocopherols

- ➔ **Tocopherol and tocotrienol homologues** (tocochromanols) are bio-compounds with a lipophilic nature and unique physico-chemical properties (e.g. important antioxidants in biological systems) and biological activity (vitamin E).
- ➔ **Vitamin E** is essential for the proper physiological functioning of human systems such as neural, vascular, musculoskeletal and reproduction.
- ➔ To date, it is believed that tocotrienols may help to prevent against cancer, diabetes, neurodegenerative and cardiovascular diseases.
- ➔ The **Recommended Daily Allowance** (RDA) of vitamin E for adult women and men was originally set at 8 and 10 mg in 1989 respectively.
- ➔ However, the value has been raised for both adult men and women to **15 mg** in 2005.

# Introduction – Beverage industry

The **juice and nectar** are the main product manufactured from sea buckthorn berries!  
The second most important product since ancient times is **oil**.

- ❑ The richest food products with tocopherols are traditional and unconventional plant oils;
- ❑ During the sea buckthorn juice production, part of the oil can be removed from the juice and may be used for other purposes.
- ❑ As the world market of food and beverage products expands daily, the nutritional value on the label is becoming highly important.





# Introduction - The nutrition label

REGULATION (EU) No 1169/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL (of 25 October 2011) on the provision of food information to consumers.....

Nutrition Information		
	Per 100 g	
	%Reference Intake RI	
Energy	485 kJ / 117 kcal	6% RI
Fat	8 g	11% RI
Of which Saturates	3,7 g	19% RI
Carbohydrate	9 g	3% RI
Of which Sugars	8 g	9% RI
Protein	1,4 g	3% RI
Salt	0,02 g	0% RI
Vitamin C	14,81 mg	19% RI
Salt content is exclusively due to the presence of naturally occurring sodium.		
Reference intake of an average adult (8 400 kJ / 2 000 kcal)		
INGREDIENTS:Mandarin Oranges (37.9%), Light Whipping Cream (Milk), Pears (12.4%), Peaches (7.7%), Thompson Seedless Grapes (7.6%), Apple (7.5%), Banana (5.9%), English Walnuts (Tree Nuts)		

**USA** - The Nutrition Facts label on packaged foods was [updated in 2016](#) to reflect updated scientific information, including information about the link between diet and chronic diseases, such as obesity and heart disease.

## Current Label

Nutrition Facts		
Serving Size 2/3 cup (55g)		
Servings Per Container About 8		
Amount Per Serving		
<b>Calories</b> 230	Calories from Fat 72	
% Daily Value		
<b>Total Fat</b> 8g		<b>12%</b>
Saturated Fat 1g		<b>5%</b>
Trans Fat 0g		
<b>Cholesterol</b> 0mg		<b>0%</b>
<b>Sodium</b> 160mg		<b>7%</b>
<b>Total Carbohydrate</b> 37g		<b>12%</b>
Dietary Fiber 4g		<b>16%</b>
Sugars 12g		
<b>Protein</b> 3g		
Vitamin A 10%		
Vitamin C 8%		
Calcium 20%		
Iron 45%		
* Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.		
	Calories:	2,000 2,500
Total Fat	Less than 65g	80g
Sat Fat	Less than 20g	25g
Cholesterol	Less than 300mg	300mg
Sodium	Less than 2,400mg	2,400mg
Total Carbohydrate	300g	375g
Dietary Fiber	25g	30g

## New Label

Nutrition Facts		
1	8 servings per container	
	Serving size	2/3 cup (55g)
2	Amount per serving	
	Calories	230
% Daily Value*		
3	Total Fat 8g	10%
	Saturated Fat 1g	5%
	Trans Fat 0g	
	Cholesterol 0mg	0%
	Sodium 160mg	7%
	Total Carbohydrate 37g	13%
	Dietary Fiber 4g	14%
	Total Sugars 12g	
4	Includes 10g Added Sugars	20%
	Protein 3g	
5	Vitamin D 2mcg	10%
	Calcium 200mg	15%
	Iron 8mg	45%
	Potassium 235mg	6%
6	* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.	

Controlling authorities...

# The aim of the study, materials

The aim of this study was to investigate the concentration range of tocopherol and tocotrienol homologues in the sea buckthorn berry beverages.

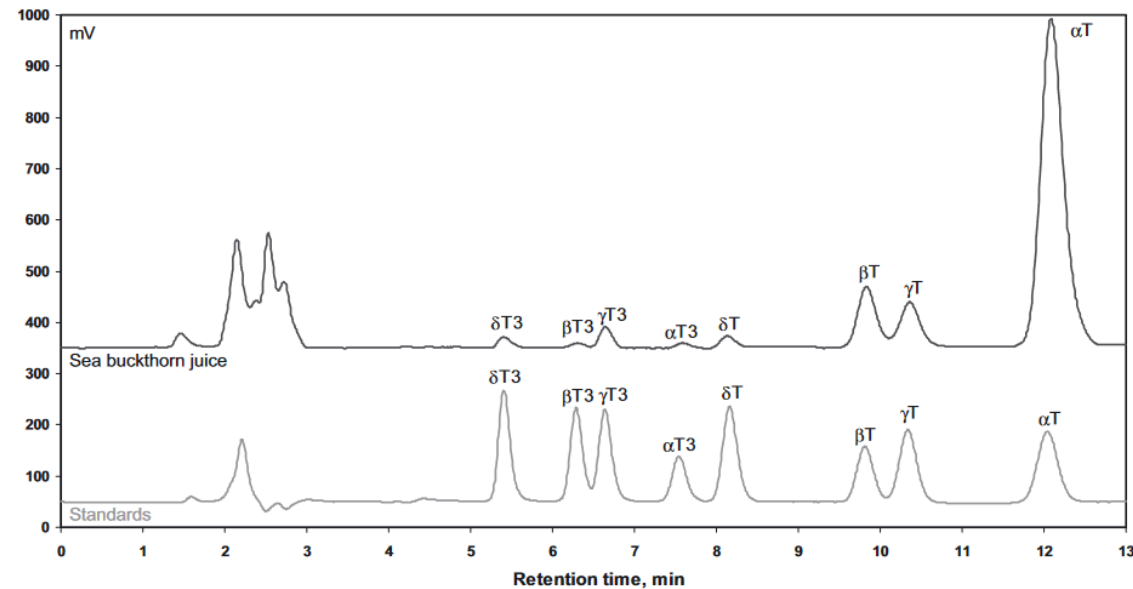
## Materials:

- ❑ 28 different products commercially available in Baltic countries;
- ❑ Additionally, the tocochromanol content was compared with juices prepared in lab-scale from 6 various cultivars ('Avgustinka', 'Botanicheskaya Lubitelskaya', 'Prozrachnaya', 'Luchistaya', 'Mary', 'Tatyana') of sea buckthorn (*Hippophae rhamnoides* L.) berries grown in Latvia.



# Methods

- ❑ Four homologues ( $\alpha$ ,  $\beta$ ,  $\gamma$  and  $\delta$ ) of tocopherol and tocotrienol standards;
- ❑ Characterization of tocopherols and tocotrienols via RP-HPLC/FLD;
- ❑ The antioxidant activity - DPPH assay.



**Figure 1.** Chromatogram of the tocopherols separated by RP-HPLC/FLD method in sea buckthorn (*Hippophae rhamnoides* L.) juice and standards.  $\alpha T$ ,  $\beta T$ ,  $\gamma T$ ,  $\delta T$  and  $\alpha T3$ ,  $\beta T3$ ,  $\gamma T3$ ,  $\delta T3$  are individual homologues of tocopherols and tocotrienols, respectively.



# Results

Tocopherol and tocotrienol homologues content in the sea buckthorn (*Hippophae rhamnoides* L.) berry beverages commercially available in three Baltic countries, (mg L<sup>-1</sup>)

Samples	<i>n</i>	a-T	b-T	g-T	d-T	a-T3	b-T3	g-T3	d-T3	Total T+T3
Location of the purchased product in the market										
Lithuania	6									
mean		24.76 ± 24.13	1.91 ± 2.02	1.03 ± 1.27	0.18 ± 0.28	0.41 ± 0.41	0.06 ± 0.09	0.66 ± 0.68	0.31 ± 0.30	29.32 ± 28.77
range		<b>0.25 – 46.47</b>	0.00 – 4.59	0.00 – 3.27	0.00 – 0.73	0.00 – 0.96	0.00 – 0.24	0.00 – 1.60	0.00 – 0.70	<b>0.25 – 62.71</b>
Latvia	10									
mean		30.32 ± 23.36	2.28 ± 1.79	0.94 ± 0.81	0.19 ± 0.16	0.84 ± 0.79	0.08 ± 0.06	1.00 ± 0.88	0.36 ± 0.19	36.01 ± 27.18
range		<b>2.02 – 64.53</b>	0.06 – 4.76	0.02 – 2.10	0.01 – 0.44	0.04 – 2.26	0.00 – 0.15	0.05 – 2.46	0.08 – 0.66	<b>2.29 – 75.90</b>
Estonia	12									
mean		21.64 ± 18.57	1.49 ± 1.47	0.63 ± 0.67	0.15 ± 0.10	0.33 ± 0.27	0.13 ± 0.05	0.53 ± 0.38	0.20 ± 0.11	25.10 ± 21.43
range		<b>4.58 – 59.09</b>	0.04 – 4.21	0.02 – 1.95	0.04 – 0.33	0.02 – 0.85	0.04 – 0.25	0.04 – 1.22	0.08 – 0.37	<b>5.60 – 67.67</b>

# Results

Tocopherol and tocotrienol homologues content in the sea buckthorn (*Hippophae rhamnoides* L.) berry beverages commercially available in three Baltic countries, (mg L<sup>-1</sup>)

Nectar*	14	a-T	b-T	g-T	d-T	a-T3	b-T3	g-T3	d-T3	Total T+T3
mean		6.83 ± 5.59	0.36 ± 0.48	0.31 ± 0.59	0.08 ± 0.12	0.13 ± 0.13	0.06 ± 0.05	0.21 ± 0.17	0.15 ± 0.12	8.11 ± 6.85
range		<b>0.25 – 20.80</b>	0.00 – 1.74	0.00 – 2.10	0.00 – 0.44	0.00 – 0.41	0.00 – 0.13	0.00 – 0.52	0.00 – 0.37	<b>0.25 – 26.33</b>
Juice	14									
mean		39.35 ± 17.18	2.99 ± 1.33	1.22 ± 0.83	0.23 ± 0.16	0.83 ± 0.59	0.13 ± 0.06	1.11 ± 0.65	0.38 ± 0.19	46.24 ± 20.00
range		<b>10.58 – 64.53</b>	0.79 – 4.76	0.20 – 3.27	0.07 – 0.73	0.20 – 2.26	0.03 – 0.25	0.38 – 2.46	0.12 – 0.66	<b>12.63 – 75.90</b>

# Results

Tocopherol and tocotrienol homologues content in the sea buckthorn (*Hippophae rhamnoides* L.) berry beverages commercially available in three Baltic countries, (mg L<sup>-1</sup>)

Two important outcomes should be highlighted:

- Firstly, the total content of tocochromanols was on average over five times higher for the juices in comparison to the nectars.
- Secondly, for each tocopherol and tocotrienol homologue in the nectars the standard deviation had approximately similar value as the mean concentration of the individual tocochromanol.
- \*According to CODEX STAN 247, nectars must contain at least 25% (v/v) of sea buckthorn juice or fruit puree.
- Based on the recorded concentration of tocochromanols, these minimum requirements were not met in some of the studied nectar products.
- Only 4 products have declared concentration of vitamin E on the label.

# Results

- ❑ The concentration of tocochromanols is **dependent on the time of harvesting** and **more importantly** on the subspecies and **cultivar** of sea buckthorn berries!
- ❑ **The storage time and conditions** of the beverages may also have an impact on **the vitamin E content**.

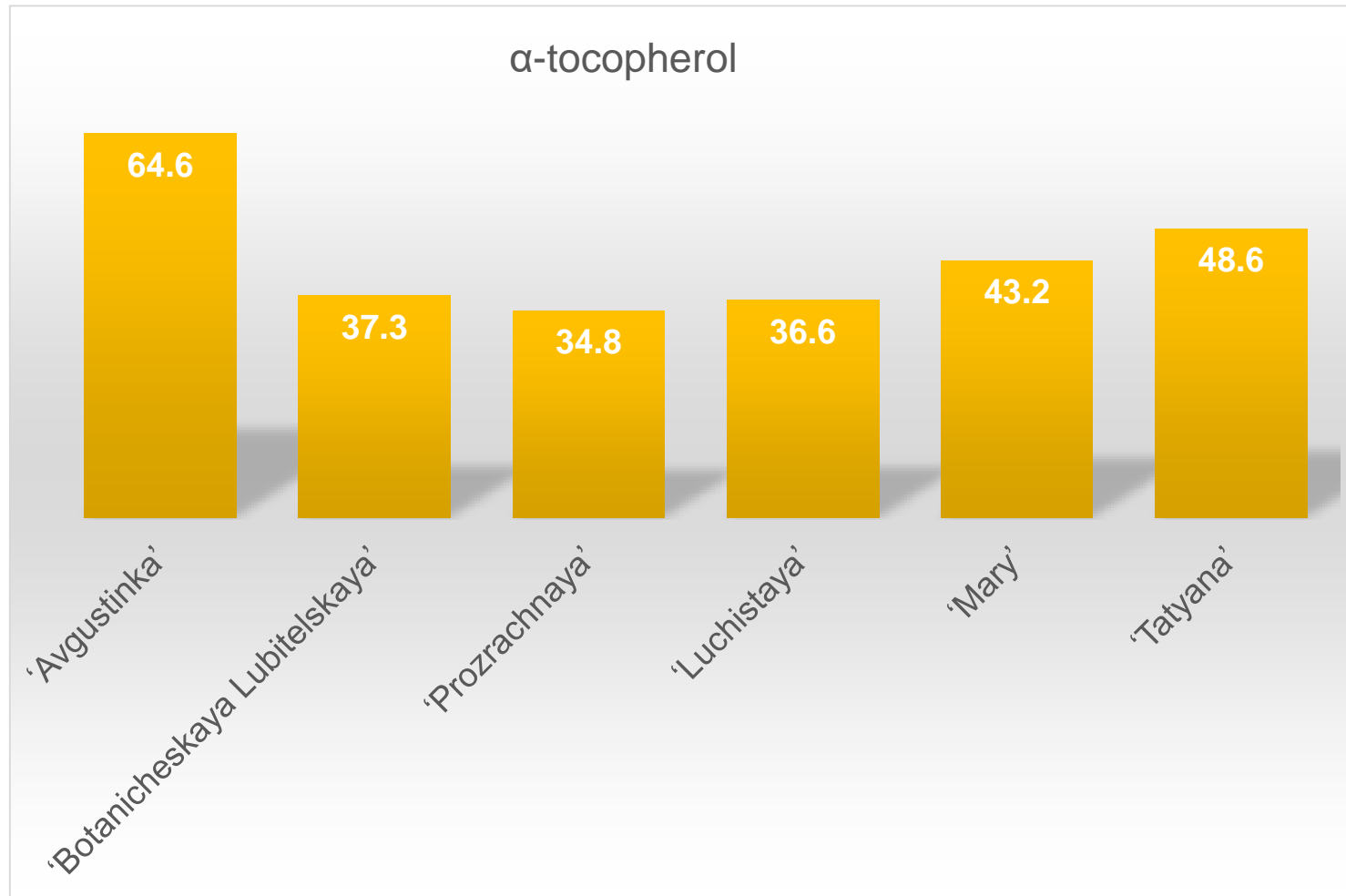


The juices from 6 various cultivars ('Avgustinka', 'Botanicheskaya Lubitelskaya', 'Prozrachnaya', 'Luchistaya', 'Mary', 'Tatyana') of sea buckthorn (*Hippophae rhamnoides* L.) berries grown in Latvia were prepared in lab-scale

# Results

Tocopherol and tocotrienol homologues content in the juice obtained on the lab-scale, (mg L<sup>-1</sup>)

(n = 3)



The α-T represented 85% of total tocochromanols in sea buckthorn juice



# Results

Tocopherol and tocotrienol homologues content in the juice obtained on the lab-scale, (mg L<sup>-1</sup>)

Samples	b-T	g-T	d-T	a-T3	b-T3	g-T3	d-T3	Total T+T3
‘Avgustinka’	4.15	1.14	0.08	1.16	0.23	1.65	0.11	73.08
‘Botanicheskaya Lubitelskaya’	2.62	0.28	0.06	1.33	0.16	1.3	0.06	43.14
‘Prozrachnaya’	1.48	0.13	0.04	1.19	0.17	1.55	0.16	39.52
‘Luchistaya’	3.32	0.32	0.06	0.44	0.01	0.69	0.14	41.6
‘Mary’	2.08	0.07	0.07	0.77	0.1	0.93	0.08	47.32
‘Tatyana’	3.21	0.42	0.03	1.11	0.03	1.05	0.05	54.5

(n = 3) T: tocopherols; T3: tocotrienols

# Results

- ❑ The average and the highest concentrations in both cases of the studied samples were very similar; however, the standard deviation is almost twice higher and **the minimum level of total tocochromanols is three-fold lower for the commercial juices compared to the obtained juices prepared in lab-scale.**
- ❑ This indicated that **the lower content of tocopherols and tocotrienols** in some commercially available sea buckthorn juices, may be the result **of recipe** (or the addition of cheaper substitutes), **different varieties or species**, as well as the **possibility, that a part of the lipid fraction was removed** from the obtained juices.

# Results

- ❑ Tocochromanols have been reported as strong lipophilic antioxidants in different model systems.
- ❑ In order to determine and compare the antioxidant activity of studied sea buckthorn beverages, a well-established and reliable DPPH assay was applied.
- ❑ The capacity in scavenging of free radicals by DPPH was associated with the concentration of tocochromanols.

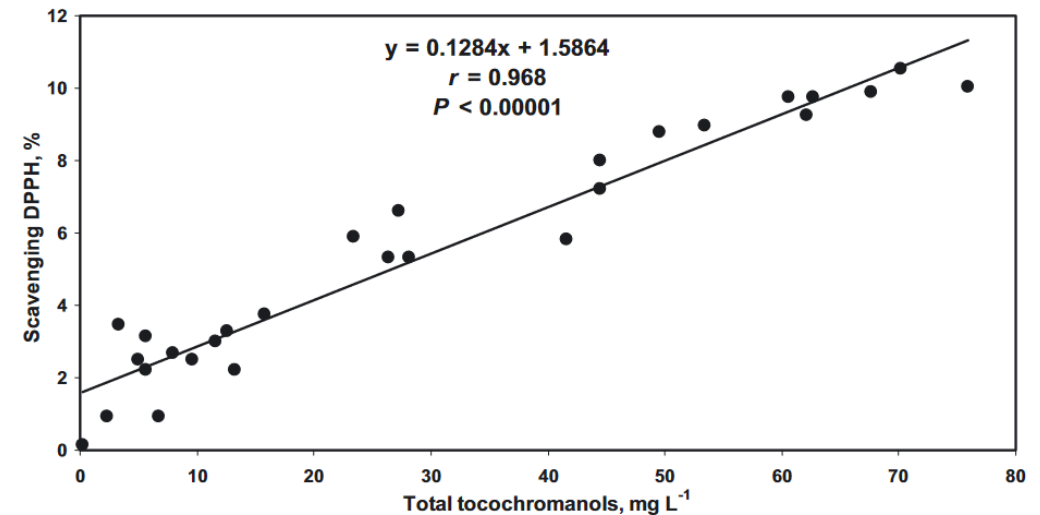


Figure 2. Correlation between the total tocochromanol content (mg L<sup>-1</sup>) and the DPPH radical-scavenging activity (%) of sea buckthorn beverages' saponified fractions.

A significant correlation ( $r = 0.968$ ,  $P < 0.00001$ ) between the total content of tocochromanols in the sea buckthorn beverages and scavenging of free radical DPPH were established.

# Conclusion

- ❑ The commercially available sea buckthorn berry beverages had a wide range of the tocopherol content (0.25–75.90 mg L<sup>-1</sup>).
- ❑ The findings of this study highlighted that only part of the sea buckthorn berry beverages, the juices, can be considered as a rich source of tocopherols, mainly in the form of  $\alpha$ -T (85%).
- ❑ The results of the DPPH assay showed a strong association between the concentrations of tocopherols in the sea buckthorn beverages with the antioxidant activities of the tested samples.
- ❑ From a nutritional point of view the inclusion of the tocopherol content on the label of the sea buckthorn beverages should be included, to facilitate an improved consumers' control on their vitamin E daily dietary intake.

# Recommendations for manufacturers

- ❑ It is important to use the same raw materials (sea buckthorn cultivars) when developing new products.
- ❑ The optimal ratio of red and yellow sea buckthorn berries has a positive effect on the taste, aroma, and color of the juice (including nectar).
- ❑ It is also important to assess the sugar and acid content of the berries.





# THANK YOU FOR THE ATTENTION!



Many thanks to my colleagues Paweł, Inga and Inta for their invested work!

*Fruits*, 2016, vol. 71(6), p. 399-405  
© Cirad / EDP Sciences 2016  
DOI: [10.1051/fruits/2016030](https://doi.org/10.1051/fruits/2016030)

**FRUITS**

Available online at:  
[www.fruits-journal.org](http://www.fruits-journal.org)

## ORIGINAL ARTICLE

**Tocopherol and tocotrienol contents in the sea buckthorn berry beverages in Baltic countries: Impact of the cultivar**

Paweł Górnaś\*, Inga Mišina, Inta Krasnova and Dalija Segliņa

Institute of Horticulture, Latvia University of Agriculture, Graudu 1, Dobele, LV-3701, Latvia