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INFLUENCE OF *STEVIA* PRODUCTS ON BIOCHEMICAL AND ORGANOLEPTIC PROPERTIES OF TEA, COFFEE AND HERBAL DRINKS

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ABSTRACT

The need for natural antioxidants and phenolics additives is constantly growing, there are a number of aspects that need to be studied before the introduction of technology into production. Therefore, in presented work was studied the antioxidant properties of *Stevia* products that exist on the European market with comparison them to extracts of *in vitro* cultures of *Stevia* plants. The highest antioxidant activity was observed in leaf crops (89%) of *in vitro* cultures of *Stevia rebaudiana* which further were selected as components for the development of beverages based on tea, herbs and coffee with improved organoleptic properties. It was estimated that antioxidant activity in different varieties of tea, herbal drinks and coffee was lower compared to the same kinds plus 10% *S. rebaudiana* leaf culture extracts to be added to beverages. The profile of phenolic compounds in *Stevia*, tea and coffee consists of a wide range of compounds of phenolic nature, which includes phenolic acids, anthocyanins, flavonoids, catechins but shown different composition. Organoleptic evaluation of beverages (black, green, aronia, hibiscus, chamomile, mint, mate teas, yoga-tea, lapacho, *Coffea arabica*) and its change under the influence of *Stevia* additives has been presented.

Keywords: *Stevia*, beverages, antioxidant activity, phenolic compounds

INTRODUCTION

Recently, the demand in the food and pharmaceutical industries for natural antioxidants to replace synthetic analogues has increased **(Augustyniak et al., 2020)**. It is believed that free radicals involved in lipid peroxidation play an important role in many chronic pathologies, such as cancer and cardiovascular disease **(Gabr A *et al.*, 2012).** In this regard numerous researches in which it is shown that phenolic compounds are endowed with strong antioxidant properties are carried out **(Sytar *et al.*, 2015; Zengin *et al.*, 2020).** It was discovered that in the human diet are coffee brew and tea leaves infusion is very significant sources of antioxidants of phenolic nature. Therefore, actual to study content of phenolic compounds in different varieties of tea, herbal drinks and coffee **(Yang and Liu, 2013, Jeszka-Skowron *et al.*, 2021)**.
Tea, herbal beverages, and coffee rank among the most widely consumed herbal drinks **(Statista, 2021)**. The cultivation of Coffea arabica, Coffea robusta, and Camellia sinensis, as well as the production of herbal infusions derived from plants like chokeberry, fennel, hibiscus, chamomile, and rooibos, hold significant economic and social importance **(Patay et al., 2016; Chandrasekara & Shahidi, 2018)**.
According to the **Global Market Report on Tea (2021)**, world tea production has seen consistent growth over the past decade, averaging an annual increase of 4.7% and reaching 5.89 million tons **(Dufrêne, 2020)**. The surge in tea production is primarily attributed to China, where production nearly doubled between 2009 and 2018, reaching 2.616 million tons in 2018, accounting for 44.4% of global production **(Dufrêne, 2020)**. Concurrently, as outlined in the **Global Market Report on Coffee (2021)**, in 2017, 70% of the $19 billion worth of total coffee production was exported **(Voora et al., 2019)**. The coffee sector is projected to experience further growth, driven by increasing demand from coffee-producing nations and emerging economies **(Lerner et al., 2021)**. A notable trend in the coffee beverage sector is the development of products with unique flavor profiles. It has also been observed that the olfactory sensory attributes have a more substantial influence on purchase intentions than taste attributes (Barahona et al., 2020). Sensory analysis serves as a potent tool for creating profiles of food and beverages based on information perceived by human senses.
The range of herbal beverages continues to expand, with an increasing share of herbal-infused teas incorporating natural sugar substitutes **(Tandel, 2011)**. Particularly noteworthy is the growing production of natural sweetened beverages using Stevia **(Reale et al., 2020)**.
Stevia rebaudiana Bertoni (family Asteraceae) is a perennial schrub that originates from Latin America (Paraguay). It is characterized by unique property to accumulate sweet tasting steviol glycosides in the leaves **(Bender, 2018).** These substances are sweeter than sugar, but at the same time they do not introduce any calories into human body. Steviol glycosides are known mostly stevioside and rebaudioside A. The stevioside and rebaudioside represent 90% by weight of all the sweet glycosides present in the leaves and have a structure with an aglycone in common. In addition to stevioside and rebaudioside A, other less abundant sweet compounds such as steviolbioside, rebaudioside B, C, D, E, F, and Dulcoside A have been isolated from the *S. rebaudiana* Bertoni leaf **(Pawar *et al.*, 2013).** All of these described diterpenoid glycosides have the similar chemical structure of steviol but vary in the carbohydrate residues at positions C13 and C19 **(Chatsudthipong and Muanprasat, 2009).** The rebaudioside A have a 30-40% of the total steviol glycosides in the leaves. The rebaudioside A is characterized by the sweetest taste, which is 180-400 times sweeter than sucrose and no bitter aftertaste **(Tavarini and Angelini, 2013).**
It was observed that the combinations of various green teas with *Stevia* resulted in extracts with varying levels of antioxidant activity. Notably, the tea with the lowest antioxidant activity, oolong tea, exhibited an enhancement in its antioxidant profile when mixed with *Stevia* **(Shevchenko et al., 2013)**.
Currently, there is a limited body of research exploring the biochemical and sensory attributes of *Stevia* products in relation to tea, coffee, and other well-known herbal beverages. Consequently, the objective of this study is to formulate recipes for soft beverages incorporating *Stevia rebaudiana* leaves or established *Stevia* products. The aim is to enhance both the taste and functional qualities, particularly the antioxidant properties, of these beverages.

MATERIAL AND METHODS

Plant material

In presented study were utilized various beverages commonly found in major teashops, including black tea, green tea, aronia tea, hibiscus tea, chamomile tea, mint tea, mate tea, yoga tea, lapacho tea, *Coffea arabica*, and Coffea robusta.

In our laboratory, we established an in vitro sprout culture using *Stevia rebaudiana* seeds sourced from "Samenhaus" (EAN: 7640126486451). Table 2 provides details regarding the phenolic content composition of the plant material.

Equipment

2 ml vials (Eppendorf). Analytical balance, 300-g capacity with resolution k1.0 mg. Pipettes (1 ml). Centrifuge 5804R (Eppendorf). Analytical spectrophotometer Jenway 6505 UV/Vis (Patterson Scientific Ltd., Luton, UK). Vortex MS2 Minishaker (Thermo Scientific, UK). Disposable 1cm-photometric cuvette (Eppendorf).

Reagents and standards.

Materials used: 1,1-diphenyl-2-picrylhydrazyl (DPPH) (Fluka), distilled water, methanol (Sigma), Folin-Ciocalteu solution, Na2CO3, gallic acid (Sigma).
Mixture Preparation: The dried and ground plant materials from *Camellia sinensis* and *Stevia rebaudiana* were analyzed both before and after mixing. The tea-stevia blend consists of 75% green tea and 25% Stevia by mass, a composition preferred by non-expert panels. To simulate the five-step infusion process common in some Asian countries, each tea and tea-stevia blend was subjected to five separate extractions. Each extraction was analyzed individually in triplicate.

Radical scavenging activity

The DPPH radical scavenging assay, based on **Gabr et al. (2012)** with some adjustments, involved preparing a DPPH working solution (6 x 10^-5 mol/l) by mixing 6 ml of stock solution with 100 ml of methanol to reach an absorbance of 0.7 ± 0.02 at 515 nm. Sample extraction included adding 1 ml of 80% methanol to 0.02 g of the sample, heating at 80 ºC for 15 min, and collecting the supernatant after centrifugation (12000 rpm/11 ºC/5 min), repeating this process twice.
The collected supernatant was combined with 5 µl of it mixed with 2000 µl of the DPPH working solution and allowed to react for 30 minutes. Afterward, absorbance at 515 nm was recorded. A control solution containing DPPH without added extract was also analyzed. Absorbance measurements were conducted against 80% methanol. The radical scavenging activity of the extracts was calculated using the following formula:

$$DPPH_{radical-scavenging\ activity}(\%) = \left(\frac{Abs_{control} - Abs_{sample}}{Abs_{control}}\right) \text{x } 100$$

Where: Abs - is the absorbance at 515 nm;
Abs control – absorbance of the control;
Abs sample – absorbance of the sample.
Photometric analyses of the samples were conducted using Jenway 6200 photometer (Patterson Scientific Ltd., Luton, UK).

Total phenolic content

The determination of total phenolic content followed the official Folin-Ciocalteu Assay method ISO 14502-1 (ISO/TC 34, 2005) designed for assessing substances specific to green and black teas. In this procedure, 0.5 mL of a 70% methanol solution at 70 ºC was combined with 0.02 g of each sample in an Eppendorf tube. The mixture was thoroughly blended and then heated at 70 ºC for 10 minutes using a block heater.
For spectrophotometric measurement, 1 mL of a diluted Folin-Ciocalteu solution (diluted 1:10 (v/v) in distilled water) was added to 0.2 mL of the diluted extract and mixed thoroughly. After 5 minutes, 0.8 mL of a 7.5% Na2CO3 solution was introduced. The absorbance was subsequently measured at 765 nm using spectrophotometry. Photometric analyses of the samples were performed using a Jenway 6200 photometer (Patterson Scientific Ltd., Luton, UK).
The final concentration of total phenolics in the samples was determined using the following formula:
Where:

$$\mathbf{Wt} = \frac{(\mathbf{D}\ sample - \mathbf{D}\ cross\ point\ ) \text{ x } \mathbf{V}\ sample \text{ x } \boldsymbol{d}}{\mathbf{S}\ stand \text{ x } \mathbf{M}\ sample \text{ x } 10000 \text{ x } \mathbf{W}tm,sample};$$

D sample – photometric extinction for the sample;
D cross point – cross point of the calibration curve and the y-axes;
V sample – extraction volume of the sample (2ml);
d – dilution factor (in this case 100);
S stand – slope of the calibration curve;
M sample – sample mass (g);
Wtm sample – dry mass of the sample;
Wt – concentration of the phenolics in the sample (mg GAE g^{-1}).

Total flavonoids and catechins estimation

Each extract was prepared by mixing 0.5 mL of 70% methanol stock solution, 1.5 mL methanol, 0.1 mL aluminum chloride, 0.1 mL potassium acetate solution, and 2.8 mL distilled water. Sample blanks were created similarly, replacing aluminum chloride with distilled water. Absorbance at 415 nm was measured after filtration through filter paper.
A calibration curve was established using various concentrations of quercetin standard solution, ranging from 6.25 to 100 mg/mL. This was done by dissolving 10 mg of quercetin in methanol and measuring absorbance at 415 nm with a Shimadzu UV-1800 spectrophotometer.
Total catechins content was determined following the method by Ibrahim et al. (2017).

Total anthocyanin estimation

Anthocyanin quantification followed **Cai et al.'s (2011)** method. We took 10 mg of freeze-dried powder samples, dissolved them in a 79% ethanol and 1% CH3COOH solution at 85°C for 20 minutes, and clarified the extracts by centrifugation. The supernatants were collected after repeating this process thrice. Then, 50 µl of 37% HCl was added to the supernatants, which were incubated in the dark for 10 minutes. Anthocyanin content was calculated based on absorbance at 535 nm compared to a buffer.

$$\text{Total anthocyanins [mg/g DW]} = \left[\frac{\text{A. MW. DF}}{\varepsilon. 1000. \text{d. g}}\right]$$

where A = absorbance; MW = molecular weight of anthocyanins (449.2 g/mol) for cyanidin-3-glucoside (cyd-3-glu); DF = dilution factor, ε = extinction coefficient (98.2); d = distance of the tube (1 cm); g=freeze-dried weight (g).

Method of organoleptic evaluation of tea and herbal drinks

We employed the organoleptic tea evaluation method described by Ehoche et al. (2021). This evaluation encompassed the assessment of various parameters, including the product's taste, bitterness, sweetness, metallic taste, aroma, color, and overall product evaluation.

RESULTS AND DISCUSSION

To evaluate the antioxidant properties of food, various methods are employed in the industry. This is because antioxidant compounds can exhibit distinct reactions when exposed to artificial oxidants utilized in analytical studies **(Debnath et al., 2011)**. For instance, **Wang et al. (1998)** discovered that certain compounds with 2,2′-azinobis-(3-ethylbenzothiazoline-6-sulfonate) (ABTS) activity, which neutralize radicals, may not react with 1,1-diphenyl-2-picrylhydrazyl (DPPH).
One of the most commonly used approaches for assessing antioxidant potential is the analysis of DPPH activity. This method relies on the capability of antioxidant compounds to decolorize the DPPH reagent by scavenging DPPH free radicals. In a mixed solution, the presence of antioxidants reacts with DPPH, reducing the number of DPPH free radicals to the quantity of available hydroxyl groups. This reduction leads to a noticeable change in the color of the solution.
The TEAC (Trolox Equivalent Antioxidant Capacity) method is also quite common and is based on measuring the degree of discoloration of free radical inhibition. The more antioxidants in the food, the greater the discoloration of trolox, which is added to the sample **(Re *et al.*, 1999).** A model analysis of superoxide dismutase (SOD) activity, which simulates the human body system and also includes analysis, is also used to assess antioxidant activity. It allows to evaluate the absorption activity of superoxide anions, in which xanthenes and the xanthene oxidase system are used to absorb superoxide radicals.
In our prior study, we compared three different methods for detecting the presence of antioxidants **(Mohdaly et al., 2010)**. Based on the findings, we decided to utilize the DPPH method to evaluate alterations in the antioxidant properties of foods after incorporating phenolic extracts. Given the industrial significance of phenolic compounds derived from plants, which are used in the food, pharmaceutical, and cosmetic sectors, a crucial aspect of the research detailed in this paper was the practical application of the research outcomes in industrial processes.
Despite the growing demand for natural antioxidants and phenolic additives, there are several aspects that require investigation before implementing the technology in production. To address this, we examined the antioxidant properties of Stevia products available in the market and compared them with extracts from in vitro cultures **(Shevchenko et al., 2014)**.
As indicated in Table 1, in vivo lyophilized dried leaves (industrial sample) exhibited a relatively high antioxidant activity of 40%. Conversely, products like *Stevia* powder and its extracts, used as sugar substitutes, displayed low antioxidant activity. Notably, thermally dried *Stevia* leaves had an antioxidant activity of 18%, which was half as much as the material dried through sublimation at subzero temperatures. Stevia leaf powder (composed of 70% Stevia and 30% talc) exhibited a modest 3% antioxidant activity. The highest level of activity was observed in leaf crops, notably reaching 89%. Consequently, in vitro cultures of

Stevia rebaudiana were chosen as components for the development of industrial products.

Table 1 Antioxidant properties of *Stevia* products

Stevia products	%
Leaves fresh	40.2±4.0
Cell culture	74.3±2.0
Root crops	55.5± 5.0
Sprouts	89.4±3.0
Powder (70%)	1.99±0.1
Leaves dried	17.8±2.0
Liquid sugar substitute	2.5±0.1
Tabs	1.5±0.1
Stevioside extract	1.12±0.1
Stevioside powder	4.14±0.2

The task was to develop beverages based on tea, herbs and coffee with improved organoleptic properties, which belong to the category of functional products. For brewing beverages used 1.5 g of dry weight of the product per 100 ml of water. At the beginning of these studies, the content of phenolic compounds and antioxidant activity of teas, herbal drinks and coffee were measured. The obtained data showed that green tea contained 80.1 mg g^{-1} of phenolic compounds, which was twice as much as in black, yoga and mate teas, as well as in mint tea drink **(Figure 1)**. Tea drinks with fennel, hibiscus and chamomile were characterized by a low content of phenolic compounds. Both varieties of coffee contained four times less phenolic compounds than green tea and twice less than black.

As shown in the previous section, there is a direct relationship between the content of phenolic compounds and the antioxidant properties of the product, but it is not directly proportional. This is due to the fact that various phenolic compounds are characterized by their specific antioxidant properties. The profile of phenolic compounds in *Stevia*, tea and coffee consists of a wide range of compounds of phenolic nature, which includes phenolic acids, anthocyanins, flavonoids, catechins, *etc*. In the **Table 2** shows the content of these compounds in studied material.

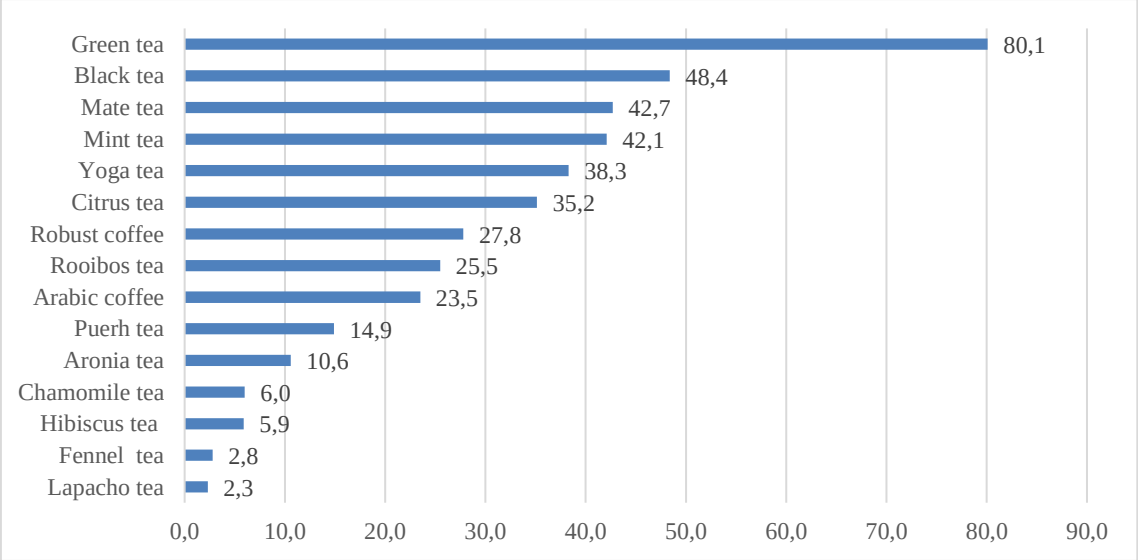

Figure 1 Content of phenolic compounds in different varieties of tea, herbal drinks and coffee (mg g^{-1}).

Table 2 Content of phenolic compounds in *S. rebaudiana*, coffee, and herbal tea in mg g^{-1}

Compounds	***Stevia rebaudiana***	***Coffea arabica***	***Coffea robusta***	**Green tee**	**Hibiscus**
Anthocyanins	2.02 ± 0.04	-	-	9.51 ± 1.55	17.24 ± 3.55
Flavonoids	15.01 ± 1.61	-	-	15.66 ± 2.05	10.31 ± 2.44
Catechins	20.88 ± 2.05	2.11 ± 0.25	3.41 ± 0.75	31.78 ± 4.11	8.15 ± 1.01

Obviously, due to the difference in the profile of phenolic compounds, they affect the functional properties of plant extracts differently. One of the important tasks in product development is the concentration of extracts. Concentrated extracts are not usually used for food development. Their concentration is selected experimentally in order to improve the organoleptic properties of the product in accordance with consumer expectations. In order to determine the optimal amount of *Stevia rebaudiana* leaf culture extracts to be added to beverages, a study using graduated dilution extracts was performed. As demonstrated in our previous studies, some extracts may develop higher antioxidant activity after dilution **(Gutiérrez *et al.*, 2009).** The results obtained when measuring the change in antioxidant activity of *Stevia* extracts and herbal drinks when diluted, are shown in **Figure 2.**

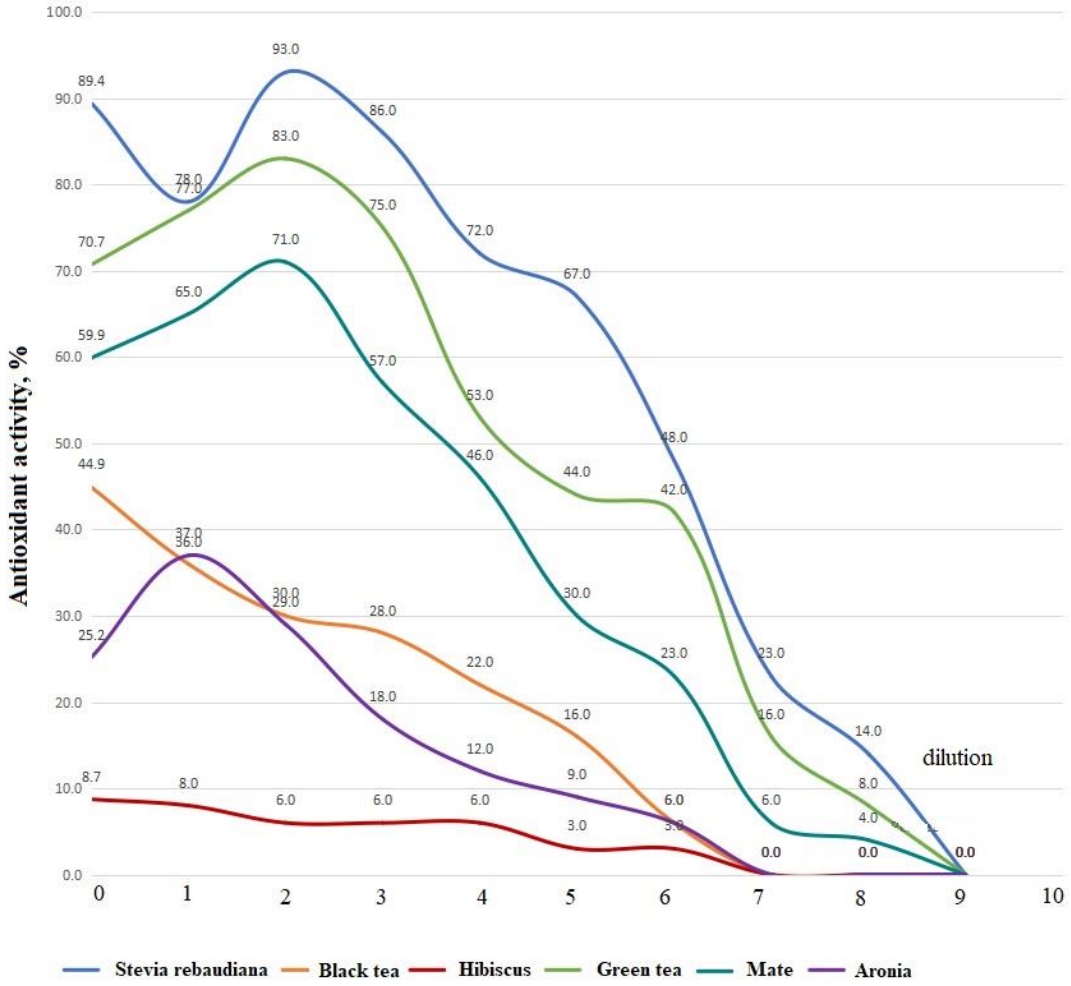

Figure 2 Changes in antioxidant activity of *Stevia* extracts and herbal drinks with dilution.

Each product was diluted 10 times, reducing the concentration of each subsequent solution by 50%. After only seven dilutions, black tea, as well as herbal drinks with chokeberry and hibiscus did not show antioxidant activity. The lowest antioxidant activity was characterized by an herbal drink with hibiscus 9%, this indicator gradually decreased to zero during 7 dilutions. A similar trend was observed for black tea, although its initial antioxidant activity was higher than in herbal drinks and was 45%.

The antioxidant activity of tea drink with chokeberry was relatively low and reached 25%, but after the first dilution increased to 37%, but after the next six dilutions decreased to zero. Green and mate teas were characterized by high antioxidant activity, which before dilution was 60 and 71%, respectively. It was also characteristic that in these teas the indicator of antioxidant activity increased to the third dilution and reached 71 and 83%, respectively.

The dynamics of changes in the antioxidant activity of *Stevia* leaf culture was similar to that in chokeberry, but was much higher and was 89% in concentrated solution, after the first dilution decreased to 78%, and after the second dilution increased to 93%. Subsequent dilutions led to a gradual decrease in antioxidant activity.

In current work, formulations of teas, herbal drinks and coffee were developed, to which 10% of *Stevia* leaf culture was added. Figure 3 shows a comparison of the antioxidant properties of different teas, herbal drinks and coffee.

In all cases, after the addition of *Stevia*, there was an increase in antioxidant activity in beverages. For example, the antioxidant activity of black tea was 45%, and after the addition of *Stevia* 55%, the antioxidant activity of La Pacho was only 2%, and after the addition of *Stevia* increased to 13%. In general, herbal drinks contained low concentrations of antioxidants, in particular a drink with fennel 4%, hibiscus 8%, and chamomile 4%.

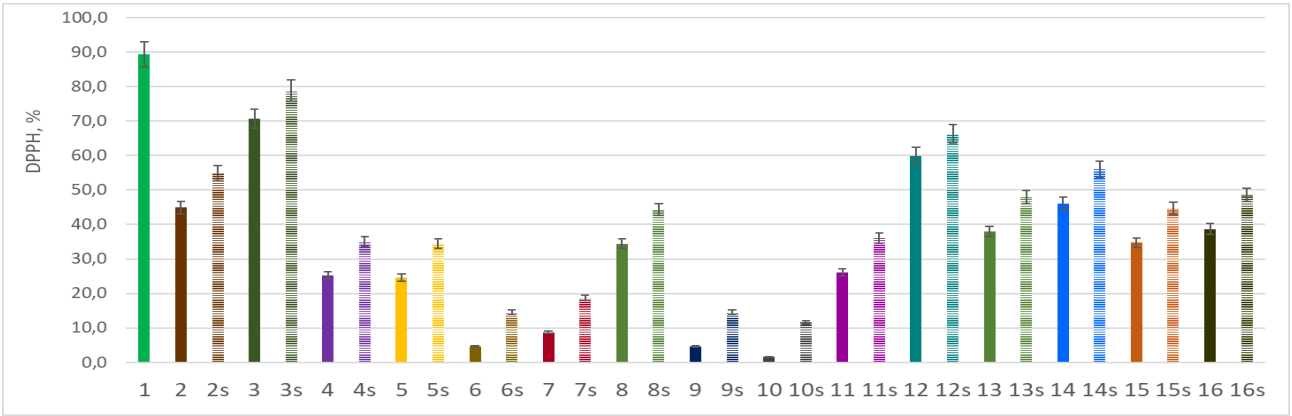

Figure 3. Antioxidant properties of teas, herbal drinks and coffee without and with the addition of *S. rebaudiana* (1 – *S. rebaudiana*, 2 - black, 2s - black + StR, 3 - green, 3s - green + StR, 4 - chokeberry, 4s - chokeberry + StR, 5 - citrus, 5s - citrus + StR, 6 - fennel, 6s - fennel + StR, 7 - hibiscus, 7s - hibiscus + StR, 8 - yoga tea, 8s - yoga tea + StR, 9 - chamomile, 9s - chamomile + StR, 10 - LaPacho, 10s - LaPacho + StR, 11 - rooibos, 11s - rooibos + StR, 12 - mate, 12s - mate + StR, 13 - mint, 13s - mint + StR, 14 - PuErh, 14s - PuErh + StR)Low concentrations of antioxidants are primarily due to the fact that in the process of processing plant raw materials, in particular by thermal drying, a significant part of antioxidants is lost, and long-term transport of raw materials from places of cultivation to processing sites negatively affects product quality.

Organoleptic evaluation of beverages and its change under the influence of *Stevia* additives was performed. This evaluation was performed by determining parameters such as product taste, bitterness, sweetness, metallic taste, aroma, color and overall evaluation of the product. These parameters were evaluated on a 5-point scale, where the worst score was 0 and the best was 5. The number of people who participated in product testing was 40 **(Table 4).** The average age of probands was 38,3 years, 23 females and 17 males.

Table 4 Organoleptic evaluation of tea and herbal drinks

	Taste	Bitterness	Sweetness	Metallic taste	Aroma	Color	Overall rating	
Stevia rebaudiana	2.0	4.2	4.6	4.3	3.6	2.2	2.7	1
Black	2.5	3.3	1.2	2	1.4	2.3	3.8	2
Black + StR	3.8	3.6	3.5	2.4	1.8	1.8	4.3	2s
Green	2.1	4.6	1.6	2.2	3.6	1.7	2.6	3
Green + StR	4.3	4	3.3	2.4	4.8	3.4	4.6	3s
Aronia	3.3	1.2	3	0.5	1.9	4.6	2.4	4
Aronia + StR	2.6	2.2	4.8	0.9	2.8	2.3	2.6	4s
Citrus	2.5	3.1	4.6	2.2	2.2	1.3	2.7	5
Citrus + StR	2.5	3.1	4.6	2.2	2.2	1.3	2.7	5s
Fennel	2.7	1.2	2.9	0	1.7	2	2.2	6
Fennel + StR	3.3	1.6	4.3	0.5	3.1	1.7	3.8	6s
Hibiscus	2.5	3.1	4.6	2.2	2.2	1.3	2.7	7
Hibiscus + StR	2.5	3.1	4.6	2.2	2.2	1.3	2.7	7s
Yoga-Tea	2.5	3.1	4.6	2.2	2.2	1.3	2.7	8
Yoga-Tea + StR	2.5	3.1	4.6	2.2	2.2	1.3	2.7	8s
chamomile	2.5	3.1	4.6	2.2	2.2	1.3	2.7	9
Chamomile + StR	2.5	3.1	4.6	2.2	2.2	1.3	2.7	9s
LaPacho	2.5	3.1	4.6	2.2	2.2	1.3	2.7	10
LaPacho + StR	2.5	3.1	4.6	2.2	2.2	1.3	2.7	10s
Rooibos	3.5	3	2.7	1	2.5	4.2	3.7	11
Rooibos + StR	1.7	3.8	4.4	1.9	1.6	3.3	2.2	11s
Mate	3.2	3.8	1.6	1.2	3.3	3.7	4.0	12
Mate + StR	4.5	4.3	3	1.9	4.7	3	4.8	12s
Mint	2.5	3.1	4.6	2.2	2.2	1.3	2.7	13
Mint, flock + StR	2.5	3.1	4.6	2.2	2.2	1.3	2.7	13s
PuErh	2.5	3.1	4.6	2.2	2.2	1.3	2.7	14
PuErh + StR	2.5	3.1	4.6	2.2	2.2	1.3	2.7	14s
Coffea arabica	2.5	3.1	4.6	2.2	2.2	1.3	2.7	15
Coffea robusta	2.5	3.1	4.6	2.2	2.2	1.3	2.7	15s

The drink, prepared by brewing a *Stevia* leaf culture, was characterized by the presence of bitterness (score 4.2 out of 5 possible), metallic taste (score 4.3), at the same time was sweet to the taste (score 4.6), had a relatively good aroma, 6) and reached an overall score of 2.7.

Combining *Stevia* with green tea significantly improved the perception of the product by probants, the overall score increased from 2.6 to 4.6, in particular due to improved taste (from 2.1 to 4.3 points), sweet taste (from 1.6 to 3.3 points), aroma (from 3.6 to 4.8 points) and color (from 1.7 to 3.4 points).

Black tea was characterized by a bitter taste (3.0 out of 5 possible), was not sufficiently fragrant (1.4) and unsweetened to taste (1.3). The overall score of black scab was 3.8 out of 5 possible points. The addition of *Stevia* to black tea improved its overall score from 3.8 to 4.3, in particular due to the taste (from 2.5 to 3.8) and sweet note (from 1.2 to 3.5), but the color of the product deteriorated (from 2.3 to 1.8), the bitter note intensified.

Fennel drink is often used as a drink that regulates digestion. It is characterized by a relatively low overall score of 2.2 points due to the presence of bitterness, lack of flavor and desired color. Adding *Stevia* to fennel drink improved the overall score from 2.2 to 3.8 mainly due to taste (from 2.7 up to 3.3 points), sweet taste (from 2.9 to 4.3 points) and aroma (from 1.7 to 3.3 points).

Herbal drink with chokeberry received an overall score of 2.4 out of 5 possible points. The use of *Stevia* as a supplement has slightly improved the perception of this drink by probands. Some criteria have been improved through the use of *Stevia*, including the sweet taste and aroma, but the color and taste of the product have deteriorated.

Unlike many beverages, the taste of rooibos deteriorated after the addition of *Stevia*, the overall score of the product decreased from 3.7 to 2.2 points, in particular due to the deterioration of taste (from 3.5 to 1.7), the appearance of bitterness, flavor and color.

Recently, mate tea is gaining popularity due to its inherent bitter taste, due to the high content of phenolic compounds. It is due to this that tea belongs to the category of functional products and in terms of price significantly exceeds other teas. However, a significant category of consumers refuses to consume this product due to its characteristic bitterness, metallic taste and lack of sweet notes. The addition of *Stevia* improves the overall evaluation of the product from 4.0 to 4.8 points mainly due to the reduction of bitter notes, sweet taste and improved aroma.

CONCLUSION

It was conducted a study to investigate the potential effects of *Stevia* products on the biochemical and organoleptic characteristics of tea, coffee, and herbal drinks. The results demonstrated a higher level of antioxidant activity in beverages containing 10% Stevia rebaudiana leaf culture extracts compared to those without *Stevia*. Furthermore, the organoleptic qualities of several studied beverages were enhanced.

The analysis of phenolic compounds in green tea, hibiscus herb (*Hibiscus*), and coffee revealed a notable presence of anthocyanins, flavonoids, and catechins in *Stevia rebaudiana* leaves, green tea, and hibiscus herb, in contrast to coffee samples. It was established that a 10% concentration of Stevia rebaudiana leaf culture extracts could be an optimal addition to beverages, enhancing their antioxidant potential. However, further research is required to delve into the nutritional changes in greater detail.

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