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EXPERIMENTAL PAPER

Antioxidant activity of teas obtained from leaves of *Camellia sinensis* (L.) Kuntze in course of various production processes available on Polish market

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Summary

Introduction: The leaves of *Camellia sinensis* (L.) Kuntze are used to produce many types of tea; this variety results from the production process. The extracts, especially from teas rich in polyphenols, are also used in the prevention and treatment of certain diseases, in addition to their application for consumption.

Objective: The aim of the study was to compare the antioxidant activity and total phenolic content in extracts from the following types of tea: white, green, oolong, black and Pu-erh.

Methods: The aqueous and methanolic extracts from the teas were analysed by spectrophotometric methods. The method with the Folin-Ciocalteu reagent was used to determine total phenolic content; the antioxidant activity was investigated by means of the reaction with the DPPH radical.

Results: Total phenolic content and the antioxidant activity of examined extracts differed significantly. The alcoholic and aqueous extracts from white and green tea of the highest content of polyphenols (97.1–84.4 mg GAE/g) showed the greatest antioxidant activity (IC₅₀ 0.263–0.329 mg/ml), similar to that of BHA. The methanolic extracts from black and Pu-erh tea demonstrated much weaker activity.

Conclusions: The antioxidant activity of extracts from investigated teas is closely correlated with content of polyphenolic compounds, which depends on the type of tea and the solvent used for extraction.

Key words: *Camellia sinensis*, white tea, green tea, oolong tea, black tea, Pu-erh tea, antioxidant activity, DPPH, phenolic compounds

INTRODUCTION

The name “tea” refers both to leaves collected from tea shrub *Camellia sinensis* (L.) Kuntze and to the infusion made from them. Tea leaves, apart from the consumption application, are also used to prevent and support the treatment of civilisation diseases, and play an important role in cosmetology [1-2].

Tea leaves contain over 2 thousand of various components, among which polyphenols (up to 36%) are the dominant ones. In this material there are also 15–20% of proteins, up to 20% of carbohydrates (including approx. 17% of fibre), about 5% of alkaloids (particularly caffeine), 5% of mineral compounds, 4% of amino acids, 2% of fats and, in addition, organic acids, chlorophyll, β -carotene, vitamins and volatile components [3-6].

For tea production only the first 2-3 young leaves are picked, or in the case of white tea – undeveloped leaf buds of *C. sinensis*. Depending on the production process in the course of which oxidation and/or fermentation processes of the raw material occur to different extents, it is possible to obtain all the known types of tea, varying in the chemical composition and properties, from the same plants:

1. non-fermented, or rather non-oxidised teas (white and green tea) – after harvesting, the raw material is instantly subjected to the influence of water vapour in order to stop the activity of enzymes, such as polyphenol oxidase, which protects the polyphenolic compounds against conversion (oxidation, condensation) and the vitamins against degradation. The chemical composition of these teas is the same as that of the producing plants

2. partially (15–80%) oxidised teas (red teas: oolong) – the leaves are left for a short time (4–5 hours) until they wither; during this time enzymatic oxidation takes place; then, they are dried in order to stop further activity of the enzymes;

3. fully oxidised teas (black tea) – after withering, the leaves are crushed and rolled so that they release sap containing enzymes necessary for oxidation leading to oxidative polymerization of the majority of simple phenolic compounds to more complex structures, e.g. theaflavins, thearubigins, which give the tea its dark colour and specific taste;

4. fermented teas (Pu-erh teas, oxidised to a maximum of 75%) – drying the leaves at appropriate temperature and humidity causes the loss of approx. 70% of water and controlled enzymatic oxidation of some catechins. Next, the moist mass is subjected to long-lasting fermentation under the influence of the bacteria and fungi present on the leaves. Good Pu-erh teas mature for a few, usually 7–10, years.

In order to accelerate the fermentation and shorten the tea maturation time, microorganisms are added from the outside, which, however, worsens the end product quality. The compounds found in Pu-erh tea in the greatest quantities are condensed polyphenols: besides theaflavins and thearubigins, mainly theabrownins giving it the colour and taste [5-8].

The health-promoting properties of *C. sinensis* have been known for ages; initially the infusions were applied because of their stimulating activity, improving concentration and mood. At present, the antioxidant activity, for which the phenolic compounds are mainly responsible, is an important direction of tea activity. The diverse quantities and types thereof, resulting from the course of the production processes, cause discrepancies between the extents of the antioxidant activity of the different teas [1, 3, 4, 9].

The strongest activity characterises catechins, also responsible for the tart taste and astringent properties of the infusions, particularly of white and green teas. The main compound of the phenolic fraction is epigallocatechin gallate (EGCG) – the most active antioxidant of these teas (20 times stronger than vitamin C). The following are also present in tea: epigallocatechin (EGC), epicatechin gallate (ECG) and epicatechin (EC). Phenolic compounds, especially EGCG, show an ability to scavenge free radicals, quench singlet oxygen and chelate metal ions which are catalysts of free radical reactions. The reduction potential of these compounds depends to a large extent on their chemical structure, including the number and location of the free hydroxyl groups. Polyphenols increase the activity of endogenous antioxidative enzymes, e.g. superoxide dismutase, glutathione peroxidase, and prevent oxidation of low molecular weight antioxidants such as vitamin C, E and β -carotene [4-7, 10-13].

Thanks to the presence of phenolic compounds, green tea is recommended, among other things, in the prevention of cancer, circulatory and heart diseases [4, 11, 12, 14] as well as normalisation of the blood sugar level [4, 15, 16] and treatment of obesity and support of weight loss [2, 4, 17, 18]. The theaflavins found in black tea lower the cholesterol level in blood, and the red thearubigins stimulate digestive tract peristalsis [6, 7]. The theabrownins present in the Pu-erh tea are of hypolipemic properties [13].

The aim of this study was to compare the antioxidant activity and to determine the total content of phenolic compounds in aqueous and alcoholic extracts obtained from five different types of tea: white, green, oolong, black, and Pu-erh.

MATERIAL AND METHODS

Plant material

The material for the study consisted of five types of tea produced from the Chinese tea, *Camellia sinensis* (L.) Kuntze, leaves; namely, white, green, oolong, black, and Pu-erh tea. The first four types of tea are certified products of Touch Organic (China), while the Pu-erh tea comes from "KAWON-HURT" Nowak sp.j. from Gostyń (Poland). All the teas were bought at a store in Poznań.

Standards and reagents

Methanol and sodium carbonate were obtained from POCh (Gliwice, Poland), gallic acid – from Carl Roth GmbH Co. (Germany), Folin-Ciocalteu reagent – from Merck (Darmstadt, Germany), DPPH radical (2,2-diphenyl-1-picrylhydrazyl) – from Sigma-Aldrich (USA) and butylhydroxyanisole (BHA) – from Fluka (France). Absorbance was measured using a Lambda 35 UV/VIS spectrophotometer (Perkin-Elmer, USA).

Plant extract preparation

Infusions of each type of tea were prepared in the following way: the water extract (W): 1.0 g of raw material was poured over with 20.0 ml of boiling distilled water and left under a cover for 30 min; the methanol extract (M): 1.0 g of raw material was extracted twice with 20.0 ml of methanol in an ultrasonic bath at 60°C for 30 min. After the extraction, the solvents were evaporated from the extracts, and the dry residue was dissolved in 250.0 ml of water to yield the extracts to be tested.

Total phenolic content

Total phenolic content was determined by the spectrophotometric method with the Folin-Ciocalteu reagent [19, 20]. An appropriate amount of one of previously prepared extracts (0.25, 0.5, 1.0 or 1.5 ml, depending on the type of tea) was pipetted into 10.0 ml volumetric flasks containing 4.0 ml of distilled water. Next, 0.5 ml of the Folin-Ciocalteu reagent and after 1 min. 2.0 ml of 20% aqueous solution of sodium carbonate were added. Distilled water was poured into the flasks to obtain a volume of 10.0 ml. After 30 min, absorbance was measured at 760 nm against the reference solution. The results were averages of five measurements. Total

phenolic content was calculated from the calibrated curve ($y=8.8507x$; $R^2=0.9991$) for standard gallic acid (concentration ranging from 0.001 to 0.006 mg/ml). The results are expressed as mg of gallic acid per g of dry weight of the material (mg GAE/g).

Antioxidant activity

The antioxidant activity was determined by the spectrophotometric method based on the reaction with the DPPH free radical [10, 19]. A methanol solution of the DPPH radical (0.0062 g/100 ml) and the basic extracts from the examined teas at 6 different concentrations (0.05–8.0 mg of plant material per 1 ml of the final solution) were used. The samples to be used for the determination were prepared by mixing 1.4 ml of the DPPH solution with 0.2 ml of the extract at a specific concentration. The reaction mixture was shaken and then incubated for 30 min at room temperature, in darkness. After that, absorbance (A) was measured at 536 nm against blank. The antioxidant activity (AA) determined as % of the DPPH free radical scavenging in the samples was calculated according to the following formula:

$$AA (\%) = [A_0 - A_x / A_0] \times 100,$$

where A_0 was the absorbance of the control sample (containing all reagents, except for the examined extracts) and A_x was the absorbance of the tested sample.

The IC_{50} parameter, showing the concentration of the material in an extract necessary to scavenge 50% of the DPPH radical, and the $1/IC_{50}$ parameter, helping to determine the correlation between the antioxidant activity and total phenolic content in the tested extracts, were determined from the obtained results (averages of five measurements for each concentration). BHA solution (0.05–1.00 mg/ml) was used as a positive control.

Statistical analyses

The results of this study have been presented as a mean of five replicates \pm the confidence interval determined on the basis of Student's t-test ($p < 0.05$). The IC_{50} values were determined from the plot of the antioxidant activity and the concentration of the raw material in the solution. The correlation between the antioxidant activity ($1/IC_{50}$) and total phenolic content was analysed using the simple linear regression, from which the determination coefficient (R^2) was calculated. All the calculations and statistical analyses were conducted with use of the Microsoft Excel

2010 software.

Ethical approval: The conducted research is not related to either human or animal use.

RESULTS AND DISCUSSION

The study presents an investigation into the antioxidant activity, correlated with the simultaneously determined content of total phenolic compounds in aqueous (infusions) and methanolic extracts from

five different types of tea: white, green, oolong, black and Pu-erh (tab. 1, 2, fig. 1).

Total phenolic content in the extracts from the investigated teas differed significantly and ranged from 97.10 to 5.65 mg GAE/g d.m. (tab. 1). The methanolic extracts and infusions of white tea contained the most phenolic compounds (97.10 and 88.37 mg GAE/g). Analogous extracts from green tea had only slightly fewer polyphenols (91.84 and 84.38 mg GAE/g). There were considerably fewer phenolic compounds in the extracts from oolong tea: 63.79 mg GAE/g in the infusion,

Table 1.
Total phenolic content of the extracts from the investigated teas

Extract	Total phenolic content [mg GAE/g]				
	White tea	Green tea	Oolong tea	Black tea	Pu-erh tea
Water	88.37±0.06	84.38±0.06	63.79±0.04	29.35±0.02	22.75±0.02
Methanolic	97.10±0.05	91.84±0.04	50.31±0.02	15.49±0.01	5.65±0.01
PW / PM*	0.910	0.919	1.268	1.895	4.040

* ratio of total phenolic content in water extracts to content of these compounds in methanolic extracts

Table 2.
Antioxidant activity of the extracts from the investigated teas

Extract	Concentration [mg/ml]	Antioxidant activity [%]					BHA
		White tea	Green tea	Oolong tea	Black tea	Pu-erh tea	
Water	0.05	10.70±1.59	10.84±0.21	6.46±0.30	2.98±0.78	–	21.42±0.30
	0.20	32.16±0.80	32.53±0.52	19.90±1.562	8.08±0.25	4.50±0.45	49.13±0.52
	0.40	62.44±1.33	56.82±0.63	45.32±1.61	–	–	58.29±0.23
	0.50	67.44±0.23	64.29±1.10	51.94±1.46	–	19.89± 0.85	60.60±0.27
	1.00	70.69±0.59	75.84±0.18	71.26±0.54	32.08±0.43	43.46±0.51	65.23±0.56
	2.00	73.46±0.41	79.60±0.42	75.27±1.26	50.77±1.08	66.05±0.53	–
	2.50	–	–	–	57.79±0.78	–	–
	4.00	–	–	–	69.26±0.58	70.49±0.56	–
	8.00	–	–	–	–	72.94±0.46	–
	IC₅₀	0.285	0.329	0.468	1.944	1.432	0.201
	1/IC₅₀	3.512	3.040	2.135	0.515	0.698	4.999
Methanolic	0.05	16.06±0.76	13.09±0.39	8.95±0.52	1.32±0.67	–	–
	0.20	35.87±1.47	38.99±0.32	27.41±1.24	3.61±0.26	2.39±0.23	–
	0.40	62.97±0.20	62.25±0.23	48.21±1.32	–	–	–
	0.50	65.12±0.59	67.97±0.13	54.12±1.06	–	6.25±0.17	–
	1.00	71.39±0.28	70.63±0.29	66.72±0.28	15.23±0.41	13.67± 1.01	–
	2.00	74.54±0.29	75.03±0.68	69.32±0.71	30.53±1.22	21.93±0.64	–
	2.50	–	–	–	37.96±0.61	–	–
	4.00	–	–	–	50.99±0.55	42.028±0.39	–
	8.00	–	–	–	–	67.40±0.61	–
	IC₅₀	0.275	0.263	0.427	3.889	5.090	–
	1/IC₅₀	3.636	3.797	2.341	0.257	0.196	–
AW/AM*		0.966	0.801	0.908	1.984	3.561	–

* ratio of antioxidant activity (1/IC₅₀) of methanol extracts to that of water extracts

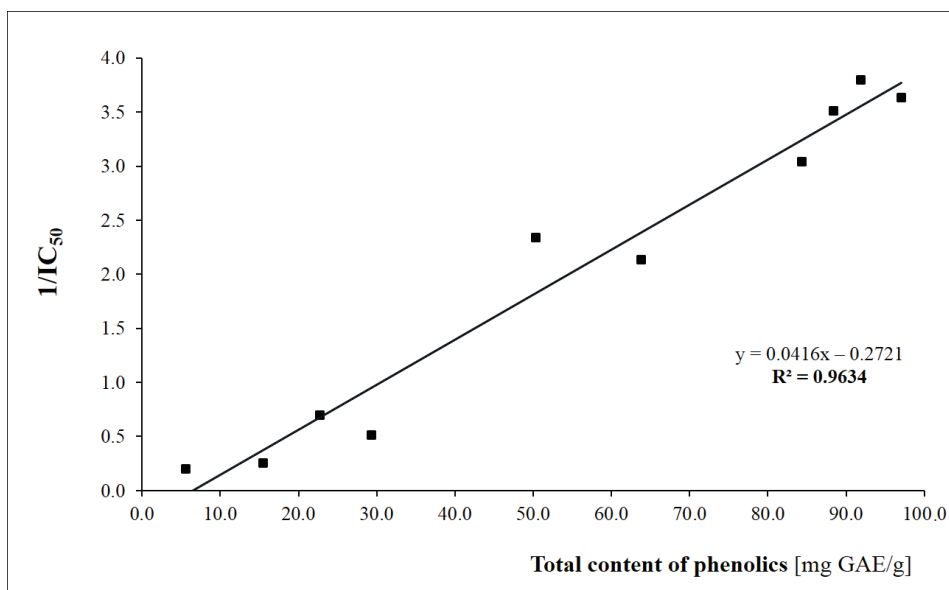


Figure 1.

Correlation between antioxidant activity ($1/IC_{50}$) and total phenolic content in extracts of investigated teas

and 50.31 mg GAE/g in the alcoholic extract. A significantly smaller quantity of polyphenols was determined in the extracts from black tea: 29.35 mg GAE/g in the infusion and about half the amount (15.49 mg GAE/g) in the alcoholic extract. Out of all the tested teas, Pu-erh contained the fewest phenolic compounds (22.75 mg GAE/g in the infusion) and, compared with white and green tea, around 17 times fewer polyphenols were found in the extract obtained via extraction with methanol (5.65 mg GAE/g), in which macromolecular theabrownins dissolved worse than in water.

In order to compare the antioxidant activity of the extracts from the investigated teas, the value of the IC_{50} parameter was determined for each of them, and to present the correlation between the ability to neutralise the DPPH free radical and total phenolic content, the $1/IC_{50}$ parameter was found as well. For comparison, the radical scavenging activity of BHA (commonly used synthetic antioxidant) was also measured in the same conditions. Table 2 shows the antioxidant activity of the tested extracts and that of the positive control (BHA).

The extracts with the highest content of phenolic compounds: alcoholic and aqueous extracts from white and green tea showed the greatest antioxidant activity, too ($IC_{50} = 0.263\text{--}0.329$ mg/ml), similar to that of BHA ($IC_{50} = 0.201$ mg/ml). These extracts were almost twice more active than the analogous extracts from oolong tea ($IC_{50} = 0.427$ and 0.468 mg/ml) and 5 – 6 times more active than the infusions of black and Pu-erh tea ($IC_{50} = 1.944$ and 1.432 mg/ml). The weakest ability to scavenge the DPPH radical

(10–15 times weaker than the extracts from white and green tea) was demonstrated by the alcoholic extracts from black and Pu-erh tea, poorest in phenolic compounds ($IC_{50} = 3.889$ and 5.090 mg/ml).

The correlation between the antioxidant activity of the examined extracts ($1/IC_{50}$) and total phenolic content has been graphically presented in fig. 1. The high value of the R^2 coefficient ($y = 0.0416x - 0.2721$; $R^2 = 0.9634$) suggests virtually full correlation ($0.9 \leq R^2 \leq 1$), which means that the antioxidant activity of the extracts from tea mainly (in 96.3%) results from the presence of the phenolic compounds and is proportional to it, both in relation to the type of the extract and the type of tea.

In order to compare the two most frequently prepared extracts from teas (drink infusions and alcoholic extracts obtained to produce preparations), the ratio of total phenolic content in the water extracts to the content thereof in the methanolic extracts was calculated (PW/PM, tab. 1), in addition to an analogous ratio of the antioxidant activity (AW/AM) of the tested extracts (tab. 2). PW/PM and AW/AM were very similar for the individual teas, and their values suggested that, in relation to the non-oxidised and non-fermented (white and green) teas, both types of the extracts were equally valuable (PW/PM=0.91 and 0.92; AW/AM=0.96 and 0.80). That is why it seems justified to recommend both infusions of these teas and preparations containing dry alcoholic extracts, e.g. OTC drugs and dietary supplements in the form of pills or capsules. In the case of black (PW/PM=1.89; AW/AM=1.98) and Pu-erh (PW/PM=4.04; AW/AM=3.56) teas, in turn,

it appears more appropriate to drink traditional infusions, which are 2 or 4 times richer in the phenolic compounds than the analogous alcoholic extracts. As far as the customarily drunk tea infusions are concerned, it is most beneficial to recommend white or green tea, since the amount of polyphenols contained in them may be balanced by as much as twice greater volume of the oolong tea and 5-6 times larger amount of black or Pu-erh tea.

The reports of other authors indicate that white and green teas of 3-4 times higher content of polyphenols than black teas also show significantly greater, even 10 times stronger, ability to scavenge free radicals [1, 2, 9, 20-22]. According to Yashin *et al.* [22], based on the determinations of antioxidant activity of various tea grades, it allows them to be classified in the following order: green > oolong > black > Pu-erh tea, which was also confirmed in our research.

CONCLUSIONS

The studies suggest high correlation between total phenolic content and anti-free radical properties of the water and methanolic extracts from five types of the examined teas, which shows that the phenolic compounds are the main components responsible for the antioxidant activity of teas. Total phenolic content and the antioxidant activity primarily depend on the tea type (the way of obtaining it) as well as on the type of the solvent used to prepare the extract. Both extracts from white and green tea displayed the greatest antioxidant activity, whereas the weakest effect was shown by the alcoholic extracts from black and Pu-erh teas. The extracts from oolong tea demonstrated medium properties.

Conflict of interest: Authors declare no conflict of interest.

REFERENCES

1. Camargo LEA, Pedroso LS, Vendrame SC, Mainardes RM, Khalil NM. Antioxidant and antifungal activities of *Camellia sinensis* (L.) Kuntze leaves obtained by different forms of production. *Braz J Biol* 2016; 76(2):428-434. doi: <http://dx.doi.org/10.1590/1519-6984.18814>
2. Unachukwu UJ, Ahmed S, Kavalier A, Lyles JT, Kennelly EJ. White and green teas (*Camellia sinensis* var. *sinensis*): variation in phenolic, methylxanthine, and antioxidant profiles. *J Food Sci* 2010; 75(6):C541-C548. doi: <http://dx.doi.org/10.1111/j.1750-3841.2010.01705.x>
3. Sang S, Lambert JD, Ho CT, Yang CS. The chemistry and biotransformation of tea constituents. *Pharmacol Res* 2011; 64(2):87-99. doi: <http://dx.doi.org/10.1016/j.phrs.2011.02.007>
4. Saeed M, Naveed M, Arif M, Kakar MU, Manzoor R, El-Hack ME, Alagawany M, et al. Green tea (*Camellia sinensis*) and L-theanine: Medicinal values and beneficial applications in humans. A comprehensive review. *Biomed Pharmacother* 2017; 95:1260-1275. doi: <http://dx.doi.org/10.1016/j.biopha.2017.09.024>
5. Cabrera C, Artacho R, Rafael Gimenez R. Beneficial effects of green tea – a review. *J Am Coll Nutr* 2006; 25(2):79-99. doi: <http://dx.doi.org/10.1080/07315724.2006.10719518>
6. Preedy Victor R. *Tea in Health and Disease Prevention* Academic Press, Amsterdam-Tokyo 2013.
7. Den Braber K, Sato D, Lee E. *Farm and Forestry Production and Marketing Profile for Tea (Camellia sinensis)*. Specialty Crops for Pacific Island Agroforestry; 2010.
8. Heiss ML, Heiss RJ. *The Story of Tea: A Cultural History and Drinking Guide* Hardcover. Ten Speed Press, 2007.
9. Xu Y, Zhao H, Zhang M, Li CJ, Lin XZ, Sheng J, Shi W. Variations of antioxidant properties and NO scavenging abilities during fermentation of tea. *Int J Mol Sci* 2011; 12(7):4574-90. doi: <http://dx.doi.org/10.3390/ijms12074574>
10. Mansour RB, Gargouri B, Bouaziz M, Elloumi N, Jilani IB, Ghrabi Z, et al. Antioxidant activity of ethanolic extract of inflorescence of *Ormenis Africana in vitro* and in cell cultures. *Lipids Health Dis* 2011; 10:78. doi: <http://dx.doi.org/10.1186/1476-511X-10-78>
11. Gupta J, Siddique YH, Beg T, Ara G, Afzal M. A review on the beneficial effects of tea polyphenols on human health. *Int J Pharmacol* 2008; 4(5):314-338. doi: <http://dx.doi.org/10.3923/ijp.2008.314.338>
12. Lambert JD, Elias RJ. The antioxidant and pro-

- oxidant activities of green tea polyphenols: a role in cancer prevention. *Arch Biochem Biophys* 2010; 501(1):65-72. doi: <http://dx.doi.org/10.1016/j.abb.2010.06.013>
13. Lee LK, Foo KY. Recent advances on the beneficial use and health implications of Pu-Erh tea. *Food Res Intern* 2013; 53(2):619-628. doi: <http://dx.doi.org/10.1016/j.foodres.2013.02.036>
 14. Yang SC, Lambert JD, Sang S. Antioxidative and anti-carcinogenic activities of tea polyphenols. *Arch Toxicol* 2009; 83(1):11-21. doi: <http://dx.doi.org/10.1007/s00204-008-0372-0>
 15. Spadiene A, Savickiene N, Ivanauskas L, Jakstas V, Skesters A, Silova A, et al. Antioxidant effects of *Camellia sinensis* L. extract in patients with type 2 diabetes. *J Food Drug Anal* 2014; 22:505-511. doi: <http://dx.doi.org/10.1016/j.jfda.2014.04.001>
 16. Islam MS. Effects of the aqueous extract of white tea (*Camellia sinensis*) in a streptozotocin-induced diabetes model of rats. *Phytomedicine* 2011; 19(1):25-31. doi: <http://dx.doi.org/10.1016/j.phymed.2011.06.025>
 17. Lin JK, Lin-Shiau SY. Mechanisms of hypolipidemic and anti-obesity effects of tea and tea polyphenols. *Mol Nutr Food Res* 2006; 50(2):211-217. doi: <http://dx.doi.org/10.1002/mnfr.200500138>
 18. Uchiyama S, Taniguchi Y, Saka A, Yoshida A, Yajima H. Prevention of diet-induced obesity by dietary black tea polyphenols extract *in vitro* and *in vivo*. *Nutrition* 2011; 27(3):287-292. doi: <http://dx.doi.org/10.1016/j.nut.2010.01.019>
 19. Gawron-Gzella A, Dudek-Makuch M, Matławska I. DPPH radical scavenging activity and phenolic compounds content in different leaf extracts from selected blackberry species. *Acta Biol Cracov Bot* 2012, 54(2):32-38. doi: <http://dx.doi.org/10.2478/v10182-012-0017-8>
 20. Kim Y, Wampler DJ. Total polyphenol content in ready to drink teas determined by Folin-Ciocalteu method and HPLC analysis. *Sensus Technical Note* 2011; SEN-TN-0034.
 21. Friedman M, Kim SY, Lee SJ, Han GP, Han JS, Lee KR, et al. Distribution of catechins, theaflavins, caffeine, and theobromine in 77 teas consumed in the United States. *J Food Sci* 2005; 70(9):C550-C559. doi: <http://dx.doi.org/10.1111/j.1365-2621.2005.tb08304.x>
 22. Yashin A, Yashin Y, Nemzer B. Determination of antioxidant activity in tea extracts, and their total antioxidant content. *Am J Biomed Sci* 2011; 3(4):322-335. doi: <http://dx.doi.org/10.5099/aj110400322>

Aktywność antyoksydacyjna herbat dostępnych na polskim rynku, otrzymanych z liści *Camellia sinensis* (L.) Kuntze podczas różnych procesów produkcyjnych

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Streszczenie

Wstęp: Liście *Camellia sinensis* (L.) Kuntze są używane do produkcji wielu rodzajów herbat, których różnorodność wynika z procesu produkcyjnego. Wyciągi, zwłaszcza z herbat bogatych w polifenole, poza zastosowaniem spożywczym, są wykorzystywane również w profilaktyce i wspomaganiu leczenia niektórych chorób.

Cel: Celem pracy było porównanie aktywności antyoksydacyjnej i zawartości sumy polifenoli w wyciągach z herbaty: białej, zielonej, oolong, czarnej i Pu-erh.

Metody: Wyciągi wodne i metanolowe z herbat analizowano metodami spektrofotometrycznymi. Do oznaczenia sumy polifenoli użyto metody z odczynnikiem Folin-Ciocalteu, aktywność antyoksydacyjną badano w oparciu o reakcję z rodnikiem DPPH.

Wyniki: Zawartość sumy polifenoli i aktywność antyoksydacyjna badanych ekstraktów znacznie się różniły. Wyciągi alkoholowe i wodne z herbaty białej i zielonej, o najwyższej zawartości polifenoli (97,1-84,4 mg GA-E/g), wykazywały też najwyższą, zbliżoną do BHA, aktywność przeciwutleniającą (IC_{50} 0,263-0,329 mg/ml). Ekstrakty metanolowe z herbaty czarnej i Pu-erh posiadały wielokrotnie słabsze działanie.

Wnioski: Aktywność antyoksydacyjna wyciągów z badanych herbat jest ściśle skorelowana z zawartością w nich związków polifenolowych, która zależy od rodzaju herbaty i użytego do ekstrakcji rozpuszczalnika.

Słowa kluczowe: *Camellia sinensis*, herbata biała, herbata zielona, herbata oolong, herbata czarna, herbata Pu-erh, aktywność antyoksydacyjna, DPPH, polifenole