

**Резюмета на научни публикации, представени в конкурс за „Професор“  
в област на висше образование 4. Природни науки, математика и  
информатика, професионално направление 4.1. Физически науки, по  
„Физика“**

**на доц. д-р Стефка Атанасова**

1. S. Atanassova, T. Stoyanchev, D. Yorgov, V. Nachev. 2018. Differentiation of fresh and frozen thawed poultry breast meat by Near Infrared Spectroscopy. Bulgarian Journal of Agricultural Science, 24, suppl. 1, 162-168.

**Abstract:** The aim of the study is to research the feasibility of Near Infrared Spectroscopy and SIMCA classification method for discrimination of fresh and freeze-thawed chicken meat. An experiment was carried out with 4 fresh breast meats and 20 tenderloins of broiler chickens, purchased from a local meat store. All samples were measured twice - once immediately after purchase and again after frozen at minus 22°C and stored at the same temperature for 20 days, then thawed in the refrigerator at 6°C for 8 hours. NIR S measurements were performed by NIR Quest 512 spectrometer (Ocean Optics, Inc.) in the region 900-1700 nm using reflection fiber-optics probe. Differences in spectral data of fresh and frozen-thawed meat samples were found. The most significant differences were found around 938, 1018, 1310, 1374, in the region 1402-1417, around 1470 and 1584 nm. SIMCA models for discrimination of fresh and frozen-thawed meat were developed. The best models were obtained using smoothing and second-derivative transformation of spectral data, which correctly classified 100% of the samples from calibration set. The obtained recognition ratio for validation set was 94.4% for fresh meat and 96.8% for frozen-thawed meat. From the obtained results we can conclude that NIR Spectroscopy and SIMCA have a potential for discriminating fresh from frozen-thawed poultry meat.

**Keywords:** poultry breast meat; fresh meat; frozen-thawed meat; near-infrared spectroscopy; classification

2. N. G. Hristova-Avakumova, L. A. Atanasova, **S. L. Atanassova**, T. V. Vangelova, V. A. Hadjimitova. 2018. Near-infrared spectroscopy as a tool for rapid estimation of the antioxidant capacity of red wines. *Bulgarian Chemical Communications, Volume 50, Special Issue C*, pp. 321 – 326.

**Abstract:** The present investigation evaluates the feasibility of using near-infrared (NIR) spectroscopy as an accurate, fast and non-destructive analytical tool for estimation of the antioxidant properties of red wines. The evaluation of the antioxidant properties was conducted using ABTS and DPPH assays for total antioxidant activity determination. NIR measurements were performed by NIRQuest 512 spectrophotometer in the region 900-1700 nm using transmittance mode. Partial least-square regression with internal cross-validation was used for calibration models development for determination of tested parameters and SIMCA for creation of model for classification on the base of the spectral data. All the investigated wines have demonstrated better antioxidant properties in the ABTS model system compared to the DPPH one. Although the observed activity highly varied, the wines containing varieties Syrah and Malbec

presented better antioxidant effect in both model systems. The Merlot wines produced from the vineyard situated on the southern slopes of Sakar Mountain in the time interval of 2012 – 2016 denoted a tendency of decreasing SV50 values from year to year. In both model systems Merlot 2016 demonstrated the best antioxidant effect correlating to the lowest SV50 values. The determination of the antioxidant activity of the tested wines on the basis of their spectra in the NIR region revealed a high degree of accuracy of estimation. This indicates that NIR spectroscopy could be a promising technique in quantitative determination of antioxidant activity and building classification models for discrimination of wines according to their antioxidant properties.

**Keywords:** Wine, Antioxidant activity, ABTS, DPPH, NIR spectroscopy

3. Karadaev, M., Fasulkov, I., Yotov, S., **Atanasova, S.**, Vasilev, N. 2018. Determination of the gestational age through ultrasound measurements of some uterine and foetal parameters in Bulgarian local goats - Reproduction in Domestic Animals, 53, 1456–1465. ISSN:0936-6768, E-ISSN:1439-0531, <https://doi.org/10.1111/rda.13305>

**Abstract:** The aim of the current study was to determine the gestational age in goats through the measurement of some foetal and uterine structures. Twenty-four pregnant Bulgarian local goats were submitted to ultrasound foetometry by transrectal and transabdominal approaches. Ultrasound measurement of studied parameters was done at 7-day intervals during the first trimester of gestation (days 21–49) and at 14-day intervals between gestation days 49 and 133. Associations of foetometry data with foetal age were investigated by linear ( $y = a + bx$ ), quadratic ( $y = ax^2 + bx + c$ ) and exponential ( $y = ax^n$ ) equations. According to the results, some biometric parameters (uterine lumen diameter, crown-rump length, trunk diameter, biparietal diameter, foetal aortic diameter) exhibited a stronger correlation to gestational age ( $R^2 \geq 0.90$ ) and lower standard error of the estimate ( $SEE \leq 8$ ) as compared to foetal eye orbit diameter, and outer and inner placentome diameters ( $R^2 \leq 0.90$ ;  $SEE \geq 8$ ). Each of these biometric parameters could be measured in different periods of gestation, thus allowing for monitoring and determination of foetal age at almost all stages of pregnancy.

**KEYWORDS:** foetometry, gestational age, goats, ultrasonography

4. Grozeva, N. & **Atanassova, S.** (2019). Karyology of the *Chenopodiastrum* s. Fuentes et al. (Amaranthaceae) from Bulgaria. *Bulg. J. Agric. Sci.*, 25 (Suppl. 3), 131–135.

**Abstract:** The karyotypes of *Chenopodiastrum murale* and *Chenopodiastrum hybridum* were examined for the first time in their Bulgarian populations. Diploid chromosome number  $2n = 18$  was found. The karyotype of 8 pairs of metacentric and 1 pair of submetacentric chromosomes was established for the *C. murale* populations. The total length of the chromosomes varied from 1.4 to 2.55  $\mu\text{m}$ . For the populations of *C. hybridum* the submetacentric pairs of chromosomes were a total of 3 pairs and the metacentric, respectively, were 6 pairs. The total length of the chromosomes varied from 1.42 to 5.7  $\mu\text{m}$ . Clustering of the species based on karyotype features grouped them into separate clusters. Higher values for mean centromeric asymmetry (Mca) is registered for *C. hybridum*. Idiograms of the studied populations were presented.

**Keywords:** *Chenopodiastrum*; chromosome number; karyotype; Bulgaria

5. Grozeva, N., **Atanassova, S.** & Terzieva, S. 2019. Karyological study of genus *Oxybasis* Kar. & Kir. in Bulgaria. *Bulg. J. Agric. Sci.*, 25 (Suppl. 3), 124–130.

**Abstract:** A karyological study of *Oxybasis chenopodioides*, *O. glauca*, *O. rubra* and *O. urbica* was conducted and the karyotype morphology from their Bulgarian populations was reported for the first time. The studied species showed  $2n = 2x = 18$  and differed significantly in total size of chromosomes, the size of the long and the short arms. The karyotype consists of metacentric and submetacentric chromosomes and their size varied from 0.8 to 3.12  $\mu\text{m}$ . Clustering of the species based on karyotype features grouped them in 2 clusters: *O. chenopodioides* with *O. glauca* and *O. rubra* with *O. urbica* with greater karyotype similarity found between *O. rubra* and *O. urbica*. The idiograms of all studied populations have been illustrated.

**Keywords:** *Oxybasis*; karyotype; Bulgaria; idiograms

6. Shinichiro Kuroki, Roumiana Tsenkova, Daniela Moyankova, Jelena Muncan, Hiroyuki Morita, **Stefka Atanassova** & Dimitar Djilianov. 2019. Water molecular structure underpins extreme desiccation tolerance of the resurrection plant *Haberlea rhodopensis* - Scientific Reports, volume 9, Article number: 3049.

**Abstract:** *Haberlea rhodopensis* is a resurrection plant with an extremely high desiccation tolerance. Even after long periods of almost full desiccation, its physiological functions are recovered shortly upon rewatering. In order to identify physiological strategies which contribute to its remarkable drought stress tolerance we used near infrared spectroscopy to investigate the state of water in the leaves of this plant and compared it to its relative, non-resurrection plant species *Deinostigma eberhardtii*. Here we show, using a novel aquaphotomics spectral analysis, that *H. rhodopensis* performs a dynamic regulation of water molecular structure during dehydration directed at drastic decrease of free water molecules, increase of water molecules with 4 hydrogen bonds, and a massive accumulation of water dimers in the full desiccation stage. Our findings suggest that changes in water structure mirror the changes in major metabolites and antioxidants which together constitute a robust defense system underlying the desiccation tolerance of the resurrection plant, while the water dimer may hold special importance for the “drying without dying” ability.

7. R. Tsenkova, **S. Atanassova**, K. Toyoda, Y. Ozaki, K. Itoh, T. Fearn. 1999. Near infrared spectroscopy for dairy measurement: Measurement of unhomogenized milk composition. *J. Dairy Science*, 82, 11, 2344-2352.

**ABSTRACT:** The potential of near-infrared spectroscopy to measure fat, total protein, and lactose contents of unhomogenized milk was studied for use in dairy management, as a new tool for on-line milk analysis in the process of milking. Influence of the spectral region, sample thickness, and spectral data treatment on the accuracy of determination was investigated.

Transmittance spectra of 258 milk samples, collected at different stages of the milking process, were obtained with a spectrophotometer (NIRSystems 6500; FOSSNIRSystems, Silver Spring, MD) in the wavelength range from 400 to 2500 nm with sample thicknesses of 1 mm, 4 mm, and 10 mm.

The spectral region and sample thickness were found to be significant factors for milk fat and total protein determination but not the lactose determination. The best accuracy was obtained with the 1100 to 2400 nm region, 1-mm sample thickness, and the first derivative data transformation. For the spectral region from 700 to 1100 nm, close accuracy was obtained for fat with a 10-mm sample and for total protein with a 1-mm sample thickness. The sample thickness did not change

significantly the accuracy of lactose determination. Different treatments of spectral data did not improve the calibrations for fat and protein.

For the region from 700 to 1100 nm, where inexpensive on-line sensors could be used, the highest positive coefficients for fat were at 930, 968, 990, 1026, 1076, and 1092 nm; for lactose were at 734, 750, 786, 812, 908, 974, 982, and 1064 nm; and for total protein were at 776, 880, 902, 952, and 1034 nm.

**Key words:** unhomogenized milk composition, near infrared spectroscopy

8. R. Tsenkova, S. Atanassova, K. Itoh, Y. Ozaki, K. Toyoda. 2000. Near infrared spectroscopy for biomonitoring: Cow milk composition measurement in a spectral region from 1100 to 2400 nanometers. *J. Anim. Sci.*, 78, 515-533.

**ABSTRACT:** The potential of near infrared spectroscopy (NIRS; 1,100 to 2,400 nm) to measure fat, total protein, and lactose content of nonhomogenized milk during milking and the influence of individual characteristics of each cow's milk on the accuracy of determination were studied. Milk fractions were taken during milking, twice per month, for 6 mo. Samples were taken every 2nd and 4th wk at the morning and the evening milkings. Teatcups were removed at each 3 L of milk yield as determined with a fractional sampling milk meter. A total of 260 milk samples were collected and analyzed with an NIRSystem 6500 spectrophotometer with 1-mm sample thickness. Partial least squares (PLS) regression was used to develop calibration models for the examined milk components. The comparison with the reference method was based on standard error of cross validation (SECV). The obtained SECV varied from .107 to .138% for fat content, from .092 to .125% for total protein, and from .066 to .096% for lactose content, and the accuracy of the reference method (AOAC, 1990, method No 972.16) was .05% for all measured milk components. The obtained models had lower SECV when an individual cow's spectral data were used for calibration. The reduction of SECV for each cow's individual calibration, when compared with SECV for the set of all samples, differed with the different constituents. For fat content determination, the reduction reached 22.46%, for protein 26.40%, and for lactose 31.25%. This phenomenon was investigated and explained by principle component analysis (PCA) and by comparing loading of PLS factors that account for the most spectral variations for each cow and the measured milk components, respectively. The results of this study indicated that NIRS (1,100 to 2,500 nm, 1-mm sample thickness) was satisfactory for nonhomogenized milk compositional analysis of milk fractions taken in the process of milking.

**Key Words:** Milk, Fat, Protein, Lactose, Spectroscopy

9. R. Tsenkova, S. Atanassova, S. Kawano, and K. Toyoda. 2001. Somatic cell counts determination in cow milk by near infrared spectroscopy: A new diagnostic tool. *J. Animal Sci.* **79:2550-2557.**

**ABSTRACT:** The potential of near-infrared spectroscopy (NIR) in the region from 1,100 to 2,500 nm to measure somatic cell count (SCC) content of cow's milk was investigated. A total of 196 milk samples from seven Holstein cows were collected for 28, consecutive days, starting from 7th d after calving, and analyzed for fat, protein, lactose, and SCC. Three of the cows were healthy, and the remainder had periods of mastitis during the experiment. Near-infrared transreflectance milk spectra were obtained using an InfraAlyzer 500 spectrophotometer. The calibration for logSCC was performed using partial least square (PLS) regression and different spectral data pretreatment.

The best accuracy of determination was found for an equation that was obtained using smoothed absorbance data and 10 PLS factors. The standard error of calibration was 0.361, the calibration coefficient of multiple correlation was 0.868, the standard error of prediction for independent validation set of samples was 0.382, the correlation coefficient was 0.854, and the coefficient of variation was 7.63%. The accuracy of logSCC determination by NIR spectroscopy would allow health screening of cows and differentiation between healthy and mastitic milk samples. It has been found that SCC determination by NIR milk spectra is based on the related changes in milk composition. The most significant factors that simultaneously influenced milk spectra with the elevation of SCC were alteration of milk proteins and changes in ionic concentration of milk.

**Key Words:** Infrared Spectroscopy, Mastitis, Milk, Somatic Cell Count

10. R. Tsenkova, **S. Atanassova**, Y. Ozaki, K. Toyoda and K. Itoh. 2001. Near Infrared Spectroscopy for Biomonitoring: Influence of Somatic Cell Content on Cows' Milk Composition Analysis. International Dairy Journal, 11, 779-783.

**Abstract:** The influence of milk with high somatic cell count on the accuracy of near-infrared spectroscopic determination of fat, protein and lactose content of non-homogenized milk was investigated. Transmittance spectra of 258 milk samples were obtained by the NIRS6500 spectrophotometer in the 700–1100 nm region. The best accuracy for fat, protein and lactose content determination was found for calibration equations, derived from samples with low somatic cell count (SCC). The standard error of prediction increased and the correlation coefficient decreased significantly, both when equations, derived from samples with low SCC milk were used to predict the content of the examined components in samples with high SCC, and when equations, obtained for samples with high SCC were used to predict the content of the components in samples with low SCC. Therefore, milk samples with high SCC in a data set used for calibration or prediction highly influenced the accuracy of fat, protein and lactose determination.

**Keywords:** Cow milk; Chemical composition; Somatic cell count; Near-infrared spectroscopy

11. R. Tsenkova, **S. Atanassova**, H. Morita, K. Ikuta, K. Toyoda, I. Iordanova and E. Hakogi. 2006. Near infrared spectra of cow's milk for milk quality evaluation: disease diagnosis and pathogen identification. J. Near Infrared Spectroscopy, 14, 363–370.

**Abstract:** Food quality and safety, as well as bacteria identification, have become very important issues. Establishing fast and non-destructive methods for control is of great importance. The performance and safety of processed milk and milk products are influenced by the quality of the raw milk used and animal health. Cell count in udder quarter milk has been established as the main criteria by which milk abnormality is evaluated and, in addition to electrical conductivity and pathogen identification, it is also a principle means for the diagnosis of the inflammatory udder disease known as mastitis. Near infrared (NIR) spectroscopy has proved to be a fast non-destructive method for the analysis of food and agricultural products, including non-homogenised milk. In this study, we have analysed NIR spectra of udder quarter milk samples collected continuously from individual cows, at various farms, at different times of the year. We report that NIR spectra of cows' udder quarter milk, when subjected to multivariate data analysis, provides information about milk abnormality and health disorders in cows. We have developed spectroscopic models for the simultaneous measurement of somatic cell count and electrical conductivity, as well as for identification of the main mastitis-causing bacterial pathogens in cow's

udder quarter milk. These finding present NIR spectroscopy as a powerful technology for *in vivo* health monitoring, disease diagnosis at molecular level and bacteria identification.

**Keywords:** NIR, *in vivo* diagnosis, mastitis, bacteria, cell count, electrical conductivity.

12. H. Daskalov, **S. Atanassova**, T. Stoyanchev, R. Santo H. 2011. Application of near infrared spectroscopy for rapid noninvasive detection of *Listeria monocytogenes*, *Escherichia coli* and *Staphylococcus aureus* growth in foods. *Bulgarian Journal of Veterinary Medicine*, **14**, 3, 150–157.

**Abstract:** Meat and cheese samples, artificially contaminated by three bacterial species: *Listeria monocytogenes*, *Escherichia coli* and *Staphylococcus aureus* were investigated by both microbiology and near infrared spectroscopy (NIRS). The incubation of samples at 8 °C for 14 days did not result in significant increase in the number of inoculated microorganisms. During the entire experimental period, microbial counts remained within 101–103 CFU/g product. Regardless of the low bacterial contamination, NIRS analysis has successfully distinguished the contaminated samples by the SIMCA model and exhibited specific spectral differences that could be used to differentiate the specific classes according to the bacterial species.

**Key words:** cheese, foodborne pathogens, food safety near infrared spectroscopy, sausage

13. Veleva-Doneva, P., Draganova, T., **Atanassova, S.**, Tsenkova, R. 2010. Detection of bacterial contamination in milk using NIR spectroscopy and two classification methods –SIMCA and Neuro – Fuzzy classifier. IFAC Proceedings Volumes (IFAC-PapersOnline), volume 3, issue part 1, 225-229.

**Abstract:** Potential of near-infrared spectroscopy combined with multivariate classification methods for detection of bacteria in cow milk was investigated. Spectra of milk samples were obtained in a region from 600 to 1880nm. Presence of *Staphylococcus aureus*, *Streptococcus agalactiae* and other bacteria from genus *Streptococcus*, one of bacteria, causing mastitis in cows, was obtained in some of the milk samples by classical microbiological methods. One hundred milk samples negative for bacteria (class healthy) and one hundred milk samples with presence of bacteria (class contaminated) were used in the investigation. Two classification methods - Soft Independent Modeling of Class Analogy (SIMCA) and adaptive Neuro – Fuzzy Inference System (ANFIS) were implemented. SIMCA develops models for each class based on principal components (PC) that describe the variations of the spectral data. Once each class has its own model, new samples could be classified to one or another classes according to their spectra. The inputs to ANFIS were several principal components. ANFIS had only one output node, the class type. One-half of samples from each class were used as a training set for creation of SIMCA models or trained the ANFIS. The rest of the samples were used as test set for verification the obtained classifiers. SIMCA models, based on 7 PC correct classified 90% of samples from class contaminated and 88% of samples from class healthy for training data set. The results for testing the models with samples from test set were as follow: 90% of samples from class contaminated and 86% of samples from class healthy were correct classified. The average testing error for ANFIS classifier was 0.058% for class healthy was 0,032 % for class contaminated. Results of the presented experiments showed possibility to establish classifiers for identification of raw milk samples, infected with bacteria. Near infrared spectroscopy in combination with multivariate classification techniques offers an alternative approach to traditional methods with large potentials for a rapid and reliable application in microbiology, biodiagnostics and food control.

**Keywords:** milk, mastitis, NIR spectroscopy, SIMCA, Neuro – Fuzzy

14. L.A. Atanasova, N. G. Hristova-Avakumova, **S. L. Atanassova**, R. D. Ginin, M. V. Panayotov, V. A. Hadjimitova. 2018. Antioxidant properties of extracts from Daizo silkworm cocoons and relationship with near infrared spectra of intact cocoons - Bug. Chem. Comm., 50, Special Issue C, 327-331.

**Abstract:** The aim of this study is to investigate antioxidant properties of water-soluble extracts from silkworm (*Bombyx mori*) cocoons, breed Daizo and their relation to near-infrared (NIR) spectra of intact cocoons. The process of extraction with water was carried out in two stages: an ultrasonic extraction for 30 min and subsequent incubation at 60°C for 1 h. The antioxidant activity (AOA) was determined after each stage by ABTS and DPPH test. It was found that the extract exhibits radical-scavenging properties in both model systems. The incubation at 60°C increases twice the yield of substances with antioxidant properties. The measurement of the standard sericin in the same conditions shows that the AOA of the obtained extracts is not only due to the sericin, but to the other extracted components, which contributes to the observed biological effect. Comparison between the AOA of the extracts with NIR spectra of intact cocoons shows a good correlation between these properties and spectral characteristics – obtained errors of estimation were low and correlation coefficients higher than 0.96.

**Key words:** *Bombyx mori*, Daizo, Antioxidant activity, ABTS, DPPH, NIR spectroscopy

15. Tzvetkova, M., Hristova-Avakumova, N.G., Atanasova, L.A., **Atanassova, S.L.**, Panayotov, M., Hadjimitova, V. 2019. Comparative evaluation of the radical scavenging activity of cocoon extracts from different silkworm breeds. Bulgarian Chemical Communications, 51, Pages 108-112.

**Abstract:** The aim of this study is to investigate the biological activities of water-soluble extracts, obtained from different silkworm cocoon breeds (*Bombyx mori*), by various extraction methods. We determine the scavenging capacity, using ABTS and DPPH tests, of four silkworm breeds, having different cocoon colours (white, yellow, greenish and orange). The used methods of aqueous extraction were – (1) 16 h water bath at 22°C, (2) 60 min water bath at 65°C, (3) 30 min ultrasonic extraction at 22°C and (4) 30 min ultrasonic extraction at 22°C and 1 h subsequent incubation at 65°C. The UV/Vis spectra of the solutions were obtained. The extracts with the highest antioxidant potential were obtained by the last method (4), and smallest by the first one (1). The greenish cocoons have the strongest scavenger activity, while the white one have the weakest. The extract from greenish cocoons, obtained by method (1) demonstrated elevated scavenger effect compared to extract from white cocoons by method (4). Comparison between the spectra of the pure sericin and the obtained extracts shows that the results depend not only on the amount of the extracted protein, but also on other components in the extract, probably flavonoids, which may contribute. The UV/VIS spectra confirmed that the differences in the antioxidant activity are related with the other cocoons' components.

**Keywords:** *Bombyx mori*, antioxidant activity, ABTS, DPPH, UV/Vis spectroscopy

16. **Stefka Atanassova**, Petar Nikolov, Nikolay Valchev, Stoyka Masheva, and Dimitar Yorgov. 2019. Early Detection of Powdery Mildew (*Podosphaera Xanthii*) on Cucumber Leaves Based on Visible and Near-Infrared Spectroscopy. AIP Conference Proceedings 2075, 160014. <https://doi.org/10.1063/1.5091341>.

**Abstract:** This study investigates the ability of Visible-Near Infrared Spectroscopy to detect powdery mildew infection in cucumbers at a symptomless stage of the disease. Experiments were performed with the cucumber variety Sandra. Plants were infected with a suspension of spores of powdery mildew (*Podosphaera xanthii*) in three variants - single, double and triple infection. Samples for spectral analysis were taken 3, 5, 7, 9, 11 and 13 days after the infection. Reflectance spectra of cucumber leaves were collected using a USB4000 spectrometer (OceanOptics, Inc. Dunedin, Fl., USA) with a fiber optics probe. The studied wavelength range was 450-1100nm. Two approaches were used for discrimination of between infected and healthy plants – vegetative indices used in remote sensing, and soft independent modelling of class analogy (SIMCA) classification. Differences between the reflectance spectra of the healthy plants, infected plants at a symptomless stage, and plants with developed symptoms of the disease were obtained. The largest differences were found between 540 and 680 nm, which can be explained by changes in the leaf structure and chemical composition of the plant tissues during pathogenesis. The calculated vegetative indices (NDVI, Red Edge Index, Photochemical Reflectance Index, Water Band Index, Carotenoid Reflectance Index) showed differences between healthy, infected plants at a symptomless stage, and diseased plants, but the differences between the healthy group and the infected plants at a symptomless stage of the disease were not statistically significant. The developed SIMCA models based on the spectral data had an accuracy rate over 78% in predicting the infection in plants. The study shows the potential of VIS-NIR spectroscopy, coupled with chemometric classification techniques, for successful distinction of a powdery mildew infection in cucumbers at the early symptomless stage of the disease.

**Keywords:** Visible-Near Infrared Spectroscopy, Cucumber, Powdery mildew, Vegetative indices and SIMCA

17. Tzanova, M., Atanasov, V., Ivanov, M., Iliev, A., **Atanassova, S.**, Peeva, P., Grozeva, N., Gerdzhikova, M., Dinev, T. 2019. Antioxidant constituents and antioxidant activity of some red wine and red table grape varieties, cultivated in different regions of Bulgaria. Bulgarian Journal of Agricultural Science, 25, Pages 3-12.

**Abstract:** Foods that have a positive effect on human health are becoming more and more popular nowadays. Such foods are the grapes - rich in phenolic compounds, which are known as very potent bio-antioxidants. This paper presented a research made for the first time- twelve red wine varieties (Rubin, Kaylashki Rubin, Storgozia, Mavrud, Nikopolski Mavrud, Melnik 55, Bouquet, Cabernet Sauvignon, Merlot, Syrah, Mourvedre and Malbec) and eight red table varieties (Velika, Dunav, Siyana, Hybrid V5-1, Muskat Hamburg, Moldova, Palieri and Black Pearl), cultivated in different regions of Bulgaria were tested for their antioxidant activity (AA) and contents of total phenols (TPC), *trans*-resveratrol (t-RVT) and quercetin (QU). In the grape skins the parameters ranged: t-RVT- from  $2.05 \pm 0.21$  to  $14.34 \pm 1.35$  and from  $1.44 \pm 0.17$  to  $23.71 \pm 2.53$  mg/kg FW; QU from  $0.27 \pm 0.03$  to  $1.98 \pm 0.18$  and from  $0.63 \pm 0.07$  to  $2.12 \pm 0.20$  mg/kg FW; TPC – from  $17 \pm 2$  to  $371 \pm 33$  and from  $21 \pm 2$  to  $444 \pm 43$  mmol GAE/kg dm and AA – from  $23.2 \pm 1.9$  to  $59.9 \pm 5.5$  and from  $32.4 \pm 2.8$  to  $66.4 \pm 6.3$  mmol TE/kg dm for wine and table grapes, respectively. The table grape varieties had higher mean values of the parameters examined than the wine grape varieties. South Bulgaria have grape varieties with higher values of the antioxidant parameters with comparison to North Bulgaria. But, Danubian region, North Bulgaria, have wine and table grape varieties with very good antioxidant parameters and can't be ignored. The reason

for this is the agrometeorological conditions. The correlations between the determined values were positive with very high correlation coefficients.

**Keywords:** wine grapes; table grapes; antioxidant activity; total phenols, *Trans*-resveratrol; quercetin

18. Tzanova, M., Atanassova, S., Atanasov, V., Grozeva, N. 2020. Content of polyphenolic compounds and antioxidant potential of some bulgarian red grape varieties and red wines, determined by HPLC, UV, and NIR spectroscopy. Agriculture (Switzerland), 10(6),193, 1-14.

**Abstract:** Today, good food criteria also include healthy capacity. So, the wine on our table should not only have good organoleptic qualities, but should be characterized by a high healthy potential. For the first time, extensive research was conducted on commercial red wine grape varieties cultivated in different Bulgarian regions in two consecutive years. Antioxidants, including trans-resveratrol, quercetin, and total phenolic content and antioxidant potential in wine grapes and wines were determined by HPLC, UV, and NIR methods. The results obtained showed similar concentration levels compared to the same varieties, produced in other countries. Trans-resveratrol showed the greatest contribution to the radical scavenging capacity. The factor with largest impact on the content of the tested substances was definitely the variety. Among agro-meteorological condition, temperature amplitude, rain fall, and UV irradiation before ripening had strong influences. Maintaining the balance between the level of synthesized and degraded and captured antioxidants during the wine making process was crucial to preserving the antioxidant properties of the final wine product. NIR spectroscopy showed very good accuracy of determination of trans-resveratrol, quercetin, total phenolic content, and the antioxidant activity of tested grape varieties and red wines. It could be a promising technique in the quantification of their antioxidant parameters.

**Keywords:** trans-resveratrol; quercetin; radical scavenging capacity; red wine grape; red wine; HPLC; UV; NIR