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Comparative analysis and complex technological evaluation of Burley tobaccos imported and produced in South Bulgaria tobacco region

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Abstract

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A comparative analysis of different Burley tobaccos has been carried out, with the objective of providing a complex technological evaluation of the status of tobacco quality, in line with the annual changes in the varietal structure in the respective tobacco producing regions and the decisive, longer-term impact of the climatic factors on the general quality of tobacco. Imported and locally produced, in South Bulgaria tobacco producing region, Burley tobaccos were rated according to the basic parameters determining tobacco quality, including the type-characteristic indices of leaf and smoke chemical composition, expert and degustation assessment. The chemical indices of the studied Burley tobaccos revealed a good quality level, high nicotine (from 2.50% to 4.52%) and total nitrogen (from 2.96% to 3.31%) contents, very low sugar amounts (about 1%), and comparatively high ash levels (between 16.32% and 18.69%); thus suggesting no significant differentiation between the compared tobaccos, imported and locally produced. The highest grade from the expert assessment of leaf quality indices was assigned to the introduced Burley N variety (origin: Spain), followed by the local Burley 1317 variety and the imported Burley B and Burley S tobaccos (Poland); the rating being statistically validated. The results from the smoking assessment revealed the advantage of the Bulgarian Burley 1317 variety, followed by the two imported ones, and the introduced Burley N variety in the last place. The final rating of the studied Burley tobaccos from the applied complex evaluation procedure was as follows: the best quality level was registered in the local Burley 1317 variety, followed by Burley B, Burley N and Burley S varieties. The outcomes from the study might be of practical importance for the decision-making parties, in the optimization of Burley tobacco varietal structures and production in the respective regions and crop years.

Keywords: Burley tobacco; leaf quality; expert assessment; degustation

Introduction

The achievement of "marketable" leaf material in the last years has become the decisive factor in the preference choices of tobacco producing farmers towards given varieties of broad-leaf tobacco. This tendency has resulted in the introduction of new varieties in the different tobacco producing regions of Bulgaria and in an annual shift in the existing varietal structure. A number of recent investigations on Burley tobacco (Pelivanoska & Trajkoski, 2002; Hristeva & Petrova, 2009; Hristeva et al., 2011; Risteski & Kočoska, 2013; Kirkova et al., 2014; Dyulgerski, 2020) revealed that the varietal diversity, under the different soil and climatic conditions in the respective regions of the country, defined the production of leaf material with significantly different character (chemical composition, leaf quality indices, smoking

properties). The general observation in a study of the quality of Burley tobacco produced in different regions of Bulgaria was that its chemical and technological traits were inferior to those of the high-quality material originating from the typical Burley producing countries (Georgiev et al., 1987). Other studies, however, pointed out that the quality level of the Bulgarian Burley tobaccos, in certain crop years, regions and varieties, could be sufficiently high and fully competitive with that of the imported typical ones (Drachev, 2001; Drachev & Nikolova, 2006; Popova et al., 2006; Nikolova et al., 2008; Radoukova & Dyulgerski, 2018).

The characteristic features of the tobaccos of Burley variety group are the high content of nicotine and the trace amount of sugars, combined with an excellent combustibility and large-cell porous leaf structure, therefore defining their role as the key absorbents of the casing solutions added to manufactured tobacco blends (Li et al., 2017a,b; Cheah et al., 2018). These characteristics of Burley tobacco are highly appreciated by the cigarette industry, as they shape the desired qualities of contemporary American-blend cigarettes, such as accelerated combustibility, better taste and lowered tobacco weight per cigarette (i.e. higher tobacco filling capacity).

Considering the existence of certain changes in the climatic factors and their critical impact on the formation of tobacco leaf quality, an annual investigation of the quality level of the tobacco produced in the different regions of Bulgaria is strongly substantiated. Therefore, the objective of this study was to provide a complex technological assessment, in a direct comparison, of different Burley tobaccos, imported and locally produced in South Bulgaria tobacco region.

Materials and Methods

Plant material. The study was conducted in the period 2017-2018 and included four Burley tobacco varieties, as follows: two imported varieties (Burley B and Burley S, imported from Poland), one introduced (experimental) variety, Burley N (origin: Spain), and the traditionally produced (local) for the region of South Bulgaria Burley 1317 variety. The imported tobaccos were produced under the ecology of Central Europe and had undergone leaf processing (curing and fire-smoking) completely different from the air-curing technology applied in Bulgaria. The production of the local and introduced varieties was according to the agrotechnical practices adopted in the region.

In accordance with the objectives of the study, the analytical samples, imported and locally produced, were formed on the basis of the most characteristic (high quality) leaf stalk position, middle leaves (cutters, C). All leaf samples were carefully pre-sorted (equalized) in order to secure the inclusion of uniform material from each variety in the analysis.

Chemical composition of Burley tobacco leaf. The chemical indices of the leaf samples (% DW) were determined according to the standard methods, applying a continuous-flow analysis (AA II C, Technicon, USA), as follows: total alkaloids (as nicotine), ISO 15152:2003; reducing sugars, ISO 15154:2003; total nitrogen, BDS 15836:1988; mineral matter (ash content), ISO 2817:1999; and ammonia, by an adapted method of TTPI (1994). All data were presented as mean value ± standard deviation (n=4).

Tar and nicotine content in tobacco smoke. The indices of tobacco smoke composition, tar and nicotine content (mg/cig), were calculated using previously established regression correlations between tobacco and smoke components (Gueorgiev & Popova, 1999). The results referred to a standard filter-tipped cigarette, with filter rod length of 21 mm, filter filament denier of 3/35000Y, total cigarette length of 84 mm, and rod diameter of 7.9 mm.

Expert assessment. The expert evaluation of leaf quality attributes was carried out by a five-member expert panel, on coded samples (blind test). The direct comparison method was applied; the task of the experts was to complete a complex assessment of exterior leaf traits expressive of leaf quality. The agreement (unanimity) of the individual ranks and the significance of the final rating was determined by a statistical procedure including the calculation of Kendall's coefficient of concordance (W) and the F-test (at 95% hypothesis probability) (Borovikov & Borovikov, 1998).

Smoking assessment. The degustation procedure was carried out on machine-filled unfiltered coded cigarettes, with uniform firmness and dimensions, by a five-member smoking panel. The method of direct paired-comparison was applied, in full combination of the varieties. The significance of variety rating in the smoking tests was proved at 95% probability as described above (Borovikov & Borovikov, 1998).

Complex evaluation of Burley tobaccos. The complex evaluation of the studied varieties was achieved by a matrix based on the selected indices determining tobacco quality; in particular, chemical composition (by the indices characteristic of the tobacco type/variety group), smoke composition, expert and smoking assessment (Drachev & Nikolova, 2006). Each sample was assigned a rank depending on the value of the respective index, positively or negatively related to tobacco quality. In general, the sample with the maximum value of a positively correlated index achieved rank 1, followed by the rest of the samples in descending order, and vice versa. To apply the described procedure, the expert pan-

el previously generated the coefficients of importance (coefficients of relative weight) for each of the indices, which were used further to calculate the respective quality index values. The final rating of the samples in the complex evaluation was obtained from the sum of the weighed quality index values; the sample with the lowest total was that characterized with the highest complex quality, and vice versa.

Results and Discussion

Chemical indices of Burley varieties

The results from the analysis of the chemical composition of the studied Burley varieties are presented in Table 1.

As seen from Table 1, the nicotine content in the analyzed tobaccos varied in a wide range, from 2.50% (Burley S, imported from Poland) to 4.52% (Burley N, introduced Spanish variety); still, the values approximated the nicotine content characteristic for the tobacco in typical Burley producing countries. Both of the tobaccos produced in South Bulgaria region, Burley 1317 and Burley N, had significantly higher nicotine levels (3.56% and 4.52%, respectively) compared with the imported ones (2.50% and 2.75%), the latter being on the lower end of the nicotine range of the tobacco type. Our results were in agreement with the previous findings by Bozhinova & Mutafchieva (2014) about the nicotine content of local and introduced Burley lines.

As stated previously, Burley tobacco is associated with very low or trace amounts of reducing sugars; therefore, it is heavily cased in American blend cigarettes manufacture. The content of reducing sugars in all of the analyzed tobaccos was about 1%; still, the two imported varieties had a slight advantage over those produced in South Bulgaria.

The total nitrogen content varied in the range between 2.96% and 3.31%, but no significant difference between the varieties produced in Bulgaria and the imported ones was proved. In that, our results were close to the data provided by Mutafchieva & Tahsin (2015).

The ash content, together with the porosity of leaf structure, define tobacco combustibility, a key characteristic of smoking tobacco. Our results revealed a differentiation between the locally produced and the imported Burley varieties; the latter were with significantly higher ash content, about 18%, compared with the locally produced varieties, thus being closer to the typical ash ranges in Burley tobacco. The higher ash content suggested better combustibility and respectively, a more porous leaf structure in these varieties.

Ammonia content in Burley leaf tissue influences, in a negative direction, the smoking properties of tobacco, causing harshness, ammonia taste and odor; therefore, it is in a negative correlation with leaf quality, as well. The results from the study revealed ammonia contents typical for Burley tobacco, varying from 0.26% to 0.55% (Leffingwell, 1999; Drachev & Nikolova, 2006). The two varieties produced in South Bulgaria were on the lower end of that range, with identical ammonia contents, while the imported ones showed relatively higher values (0.45% and 0.55%).

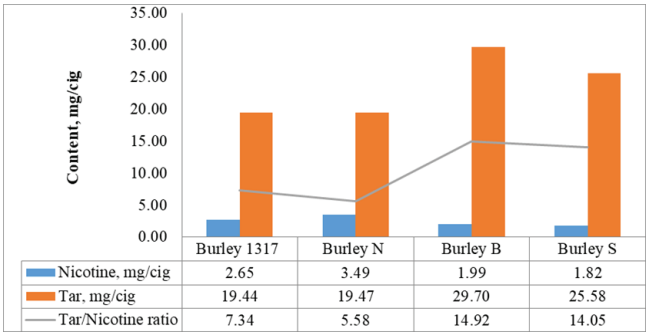
Figure 1 presents the data about the basic chemical indices of the smoke of the studied Burley tobacco varieties. The nicotine and tar values shown on the figure, as previously stated, were calculated from regression models and were not directly analyzed. Therefore, they were informative about the potential of the respective tobacco to produce smoke tar and nicotine in the applied analysis procedure, without the claim of being absolutely precise, as smoke component formation is influenced by a series of factors, apart from tobacco composition (Gueorgiev & Popova, 1999; Leffingwell, 1999).

The results revealed that smoke nicotine levels corresponded to the nicotine content variations observed in the respective leaf materials, therefore a differentiation between the two varieties produced in Bulgaria (Burley 1317 and Burley N) and the imported ones (Burley B and Burley S) could be made. Tar contents also varied in a wide range, from 19.44 mg/cig (Burley 1317) to 29.70 mg/cig (Burley B). The two tobaccos imported from Poland were with significantly higher tar levels compared with those produced in Bulgaria, with no significant differences between the samples within those two groups. The ratio between tar and nic-

Table 1. Chemical composition of Burley tobacco varieties

Index	Variety			
	Burley 1317[1]	Burley N[2]	Burley B[3]	Burley S[3]
Nicotine, %	3.56±0.02[4]	4.52±0.03	2.73±0.02	2.50±0.02
Reducing sugars, %	1.26±0.01	1.31±0.01	1.04±0.01	1.02±0.01
Total nitrogen, %	3.26±0.03	3.27±0.03	2.96±0.02	3.31±0.02
Ash, %	16.32±0.14	16.90±0.09	18.69±0.09	18.02±0.11
Ammonia (NH_3), %	0.27±0.00	0.26±0.00	0.55±0.01	0.45±0.00

[1]produced in South Bulgaria region; [2]introduced variety (origin: Spain) produced in South Bulgaria region; [3]imported varieties (Poland); [4]all data are mean values ± standard deviation (n = 4)



	Burley 1317	Burley N	Burley B	Burley S
Nicotine, mg/cig	2.65	3.49	1.99	1.82
Tar, mg/cig	19.44	19.47	29.70	25.58
Tar/Nicotine ratio	7.34	5.58	14.92	14.05

Fig. 1. Chemical indices of the smoke of Burley tobacco varieties

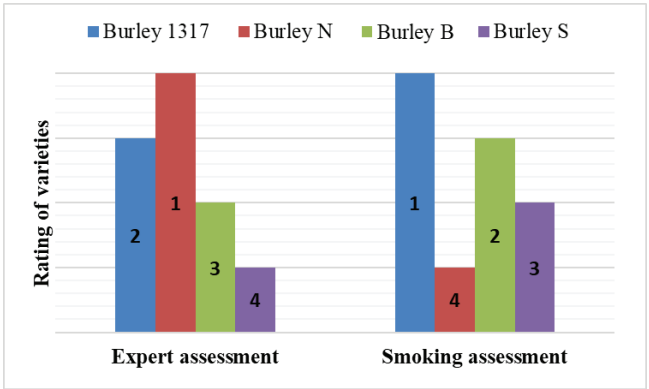


Fig. 2. Rating of Burley tobacco varieties by expert and smoking assessment

otine is an important smoke indicator, as it correlates with smoke properties; it is typically retained at about 10:1 in the manufactured blended cigarettes, but the lower-tar higher-nicotine Burley tobacco provides considerably lower ratio values, about 7:1. Therefore, the tar-to-nicotine ratios were more favorable in the two locally produced varieties.

As a general observation, the data about leaf and smoke chemical composition suggested a good quality level in all of the Burley tobacco varieties in the study. Although some variation patterns were observed, the objective chemical indices allowed for no distinct differentiation between the tobaccos produced in Bulgaria and the imported ones.

Expert assessment of Burley varieties

The individual ranking of the samples by the experts reflected the integrated sensory perception of the exterior quality indicators of cured tobacco leaves (elements of leaf quality), such as length/width, color (intensity, uniformity), structure, body, etc. The individual rankings were with high degree of concordance (unanimity) and the final rating was statistically significant at 95% probability level (W = 0.64).

The final rating of the studied tobacco varieties by the expert assessment procedure is presented on Figure 2.

As seen from the presented results, the highest rating by leaf quality elements in the expert assessment was assigned to the introduced Burley N variety (origin: Spain), followed by the local variety Burley 1317. The last two positions were attributed to the imported varieties, Burley B and Burley S (Poland), respectively.

Smoking assessment of Burley varieties

The grading procedure of the studied Burley varieties in the smoking assessment test included a direct comparison of the studied varieties, in full combination of the pairs. The ranking of the samples by each of the panelists was based on an individual matrix of preference, taking into consideration the complex perception of tobacco smoke (strength, taste, aroma, and their elements). Tobaccos with undistinguishable differences in smoke perception were assigned equal (shared) ranks. The final results from the degustation rating are also presented on Figure 2.

Table 2. Complex evaluation matrix of Burley tobacco varieties

Index	Rank				CI[4]	Quality index			
	Burley 1317[1]	Burley N[2]	Burley B[3]	Burley S[3]		Burley 1317	Burley N	Burley B	Burley S
Nicotine, %	2	1	3	4	0.20	0.40	0.20	0.60	0.80
Reducing sugars, %	3.5	3.5	1.5	1.5	0.18	0.63	0.63	0.27	0.27
Ash, %	3.5	3.5	1.5	1.5	0.12	0.42	0.42	0.18	0.18
Ammonia, %	1.5	1.5	4	3	0.10	0.15	0.15	0.40	0.30
Expert assessment	2	1	3	4	0.15	0.30	0.15	0.45	0.60
Smoking assessment	1	4	2	3	0.25	0.25	1.00	0.50	0.75
Sum of quality indices						2.15	2.55	2.40	2.90
Rating						1	3	2	4

[1]produced in South Bulgaria region; [2]introduced variety (origin: Spain) produced in South Bulgaria region; [3]imported varieties (Poland); [4]coefficient of importance

The individual ranking was found to be statistically significant and unanimous in the applied statistical analysis (with W=0.62), therefore the final rating was accepted as reliable (with 95% probability of the hypothesis). Thus, the smoking characteristics of the varieties in the study varied in the following order: the highest rating was assigned to the Bulgarian variety Burley 1317, followed by the two imported Polish varieties (Burley B and Burley S), and the introduced Spanish variety (Burley N) occupied the last place.

Complex evaluation of quality

In accordance with the objectives of the study, a complex evaluation of the regarded Burley varieties was completed, based on the most important tobacco quality attributes. Those included both objective (chemical) and organoleptic (expertise, degustation) indices, each of which with specific share in the general quality level of tobacco. Therefore, the final rating of the varieties was based on the obtained results from the consecutive stages of leaf analysis, taking into account the known correlations (positive or negative) between the obtained values and tobacco quality (Drachev, 2001; Drachev & Nikolova, 2006; Popova et al., 2006; Nikolova et al., 2008). The results from the complex evaluation of the quality of the varieties in the study are presented in Table 2. In the case of no statistically significant differences between the samples by a quality index (Table 1 and the discussion after that), they were given equal (shared) ranks.

As seen from the data in Table 2, the best complex quality level was achieved by the original Bulgarian variety, Burley 1317, followed by Burley B (Poland). The introduced Spanish variety (Burley N) and the imported Burley S variety occupied the last two positions in that descending line. The data in the table further suggested that there was no uniformity in the ranking of the varieties by the selected quality indices, chemical and organoleptic; those variations were reasonably related not only to the genetic factor, but also to the influence of production environment. The rating results in the study confirm the potential for the production of high quality Burley tobacco in South Bulgaria region (based on both locally selected and introduced varieties), which is in no way inferior to the imported Burley leaf tobacco (Radoukova & Dyulgerski, 2018).

Conclusions

The study provides a comparative analysis of four Burley tobacco varieties, two imported and two produced in South Bulgaria region. A complex technological evaluation of the varieties was conducted, based on the characteristic quality indices of the tobacco type. The results from the investigation revealed that all of the studied Burley tobaccos had favorable chemical composition, while no distinct differentiation between the compared tobaccos, locally produced and imported, could be made by the objective chemical indices. The expert and smoking assessments, based on the perception of leaf quality elements and tobacco smoke, respectively, suggested statistically significant variations between the regarded Burley varieties. The results from the complex technological evaluation procedure identified the highest total quality level in the original Bulgarian Burley 1317 variety, followed by the imported Burley B variety (Poland), the introduced Burley N variety (origin: Spain, produced in Bulgaria) and the second imported variety, Burley S. The outcomes from the study might be of practical relevance for the decision-making parties, in the optimization of Burley tobacco varietal structures and production in the respective regions and crop years.

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