Assessment of the Quality Profile of Oriental Tobacco from the Commodity Segment of Basma Variety Group (Ecotype Krumovgrad)

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Abstract. The production of Oriental tobacco has a significant role for the social status of Bulgarian farmers and the economic priorities of the regions. The demand for tobaccos that are truly competitive on the international market has forced the dominant production of Krumovgrad ecotype varieties in the country. The aim of the present research was to evaluate the quality profile of Oriental tobacco of Krumovgrad ecotype (variety Krumovgrad 90), as a significant part of the commodity segment of the Basma variety group. The study was carried out with tobaccos, produced in 10 micro regions of the Nevrokop region, 2019 crop year. Cured leaves were assessed in terms of chemical, visual and sensory quality, and the tobaccos were finally rated according to their complex quality manifestation (based on the achieved "quality index" value). The technological assessment of the quality profile of the studied Oriental tobacco of ecotype Krumovgrad proved that there were significant differences in cured leaf quality between the tobacco samples representing the same variety and crop year but grown in different areas. As a result from the complex quality evaluation procedure, the best rated was the tobacco produced in Godeshevo micro region, followed by those from Kornitsa, Furgovo and Ablanitsa. The data obtained by the study could be useful from the point of view of the technological processing of cured tobacco leaves and the objective of obtaining uniform batches of Krumovgrad ecotype tobacco within the commodity segment.

1 Introduction

The production of Oriental tobacco has a significant role for the social status of Bulgarian farmers and the economic priorities of the regions, ensuring the employment of thousands of tobacco producers. In recent years, despite declining volumes, processing companies have been trying to maintain production levels by increasing the yields per unit area and the net returns to farmers while maintaining cured leaf quality sought by manufacturers [1]. The lack of a clear and sustainable alternative to tobacco growing in specific and underprivileged areas increases the need to validate varieties that will provide the highest income (to meet growers'

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expectations) while maintaining leaf quality characteristics for cost-effective production with desirable sensory characteristics [2, 3].

The quality level and the chemical composition of Oriental tobaccos show a positive response to water stress, which is an important feature when the climate changes in the past decades are considered [1]. The small-leaf Oriental tobaccos (also known as aromatic tobaccos) are best identified by their quality characteristics and most of all – by the specific, highly intensive aroma and low nicotine content, but the relationship between the numerous components of tobacco leaf and its quality is very complex [4]. The specific quality characteristics of Oriental tobacco, described by the physical, visual, chemical, and sensory traits of the cured leaves, are strongly influenced by the interaction of genotype and environmental conditions [5-7].

The chemical quality of tobacco, expressed through the content of certain chemical components in the cured leaves, is an important factor in the development or the improvement of smoking products, as the proper balance of chemical constituents essentially defines the achievement of the desired smoke sensory properties [2, 5]. A study on the accumulation of nicotine in Oriental and other types of tobacco grown in Bulgaria found that the highest concentrations were obtained under high levels of nitrogen fertilization, reduced irrigation, lower plant density, and early topping [8]. Those practices limited starch accumulation, thus affecting the chemical balance and the sugar/nicotine ratio in the cured leaves. A study carried out with five varieties of Oriental tobacco in different regions of Greece for three successive crop years showed a significant influence of the main factors – the region, the variety and the year of cultivation, on the basic chemical quality traits [3]. Regarding the nicotine content, a significant variation was found depending on the variety, but there were no significant differences between the experimental areas. The nicotine level was the highest in Xanthi 2A (2.19-3.05%) and Xanthi 81 variety (1.77-2.60%). Leaf sugar content was significantly influenced by all three factors and varied from 2.71% to 9.78%. Significant differences in cured leaf chemical composition, depending on crops, regions, varieties, leaf stalk positions, farmer practices, and other factors, were also found in Oriental tobacco ecotypes (e.g., Prilep, Basma, and others) from other producing countries [5, 9, 10].

An investigation regarding the effect of mineral fertilization on the chemical composition of Krumovgrad ecotype tobacco produced in Bulgaria reported nicotine contents varying in the ranges 2.36-2.72% and 2.30-2.64% for the two varieties in the study, Krumovgrad 944 and Krumovgrad 17, respectively; the variation of reducing sugars content was 12.6-14.7% (Krumovgrad 17) and 11.6-12.2% (Krumovgrad 944) [11].

Our previous studies on the quality traits of local (established) and introduced (trial) varieties of Oriental tobacco in Bulgaria did not find a tendency for a better cured leaf quality in the new varieties compared to the ones traditionally grown in the country [12, 13]. It was pointed out that the differences in the quality of a given variety are more significant under the influence of the crop year, compared to the quality of the same variety in a single crop year when grown in different areas, especially in the case of higher quality harvests [14, 15].

To the best of our knowledge, similar research focusing on the complex quality of Oriental tobaccos currently produced in Bulgaria are scarce. Recently, the demand for tobaccos that are truly competitive on the international market has forced the dominant production of Krumovgrad ecotype varieties in the country (comprising about 85% of the 2019 cured Oriental tobacco crop) [16]. This objectifies the need to conduct the present research with the aim of evaluating the quality profile of Oriental tobacco of Krumovgrad ecotype, a significant part of the commodity segment of Basma variety group.

2 Materials and methods

2.1 Plant material

The comparative technological assessment of tobacco quality was carried out with tobaccos of ecotype Krumovgrad (variety Krumovgrad 90), 2019 crop year, produced in 10 micro regions of the Nevrokop region (distributed in the Yaka and Pole sub-regions, respectively) in the Macedonian tobacco area of Bulgaria. For the sake of clarity, the tobaccos provided from the respective micro regions were labelled from Sample No 1 to sample No 10, as presented in Fig. 1.

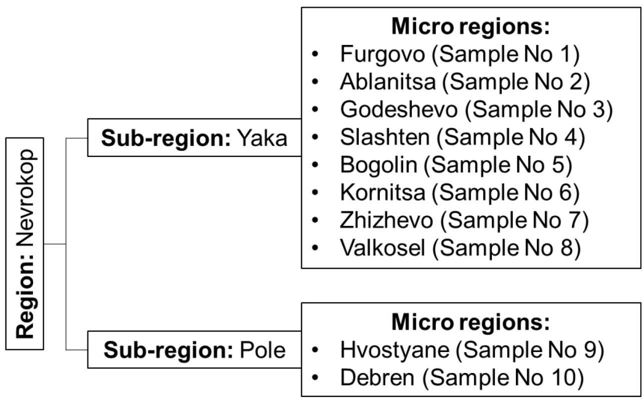

Fig. 1. Key to the production regions and designation of the Oriental tobaccos in the study.

The tobacco material was taken in the form of stringed cured leaves from different tobacco producers in each of the micro regions. The primary raw material was limited only to cured leaf from the upper stalk positions (upper middle, kovalama and ouch), i.e. the highest quality and characteristic material in Oriental tobaccos, corresponding to the "A" standard grade [17]. The analytical samples excluded highly damaged or otherwise defective leaves in order to secure uniform and representative samples for the comparative examination.

2.2 Methods

2.2.1 Determination of the chemical traits of the cured tobacco leaves

Standardized methods were applied to determine cured leaves chemical traits: nicotine [18], reducing sugars [19], total nitrogen [20], and ash [21]. All analyses were performed at the accredited laboratory of the Tobacco and Tobacco Products Institute – Agricultural Academy, Markovo, Bulgaria. The ratio „reducing sugars/nicotine" was also calculated, as an indicator of the taste balance of tobacco smoke.

2.2.2 Determination of the chemical indicators (tar and nicotine) of tobacco smoke

The indicators of tobacco smoke composition (tar and nicotine content, mg/cig) were determined through a computational procedure, based on established regression correlations between tobacco leaf and smoke composition, according to the method described by [22].

2.2.3 Expert assessment of leaf visual quality

The analysis was carried out by six highly trained experts. They evaluated the coded tobacco samples by the integrated perception of all leaf visual quality traits (e.g. body, texture, degree of maturity, color, etc.), in a direct comparison mode. The statistical significance of the obtained ranking orders by the experts (the unanimity of results) was validated by Kendall's coefficient of concordance (W) and the F-test, at 95% probability level. Generally, W values exceeding 0.50 indicate that the experts rate the samples unanimously and that the differences between the samples are reliably distinguishable (actually existing) [23].

2.2.4 Assessment of smoke sensory characteristics

The analysis was carried out by a smoking panel consisting of five experts. The ranking of the appropriately coded samples (in the form of laboratory made, non-filtered cigarettes, with uniform design parameters) was based on the integrated perception of smoke sensory characteristics (taste, aroma and impact). The statistical processing to validate the reliability of the obtained results was carried out in the same way as in the assessment of leaf visual quality.

2.2.5 Complex cured leaf quality and rating of tobaccos

The complex evaluation of tobacco quality and the final rating of the samples was based on the most important quality characteristics (chemical, visual and sensory quality traits). With regard to the leaf and smoke chemical indicators included in the evaluation matrix (nicotine, reducing sugars and the ratio between them, and tar), the samples were ranked according to the value of the respective component taking into account its correlation, positive or negative, with tobacco quality. If a positive correlation existed, the sample with the highest value of the regarded indicator received the highest rank (rank 1) and the remaining samples were ranked in descending order; and if negative – vice versa. Each of the selected quality traits was weighed in terms of its relative contribution to the complex tobacco quality, and the respective coefficient of importance (CI) was assigned to it. The rating of the samples was obtained by calculating a "quality index", thus comprehensively characterizing the complex quality of the respective tobacco. A lower value of the quality index corresponded to a higher quality.

3 Results and discussion

3.1 Chemical indices of tobacco leaves and smoke

The data from the determination of the chemical traits of the cured tobacco leaves and the smoke are presented in Table 1.

The leaf nicotine content in the tobaccos from the studied sub-regions of Nevrokop region showed relatively lower values than those typical for the Krumovgrad 90 variety – from 0.38% (Sample 4; micro region Slashten) to 0.79% (Sample 6; Kornitsa). At the same time, the reducing sugars content was relatively high for Oriental tobacco – from 18.60% to 24.20%. Those findings were in an organoleptic correlation towards prospective one-sidedness in smoke taste (with a burning sensation), given the high values of the reducing sugars/nicotine ratio (from 27.00 to 58.16). The lowest content of total nitrogen was recorded in the tobacco from the Slashten micro region (Sample 4; 0.86%), and the highest in those from microregions Zhizhevo and Hvostyane, 1.84% and 1.81%, respectively. With the highest ash content was the tobacco from micro region Godeshevo (10.89%: sample 3), while there were no significant differences between the remaining samples.

Table 1. Chemical indices of Oriental tobacco

Sample No [a]	Index						
	Tobacco composition					Smoke composition	
	Nicotine (%)	*Reducing sugars (%)*	*Reducing sugars / Nicotine*	*Total nitrogen (%)*	*Ash (%)*	*Nicotine (mg/cig)*	*Tar (mg/cig)*
1	0.46	19.80	43.04	1.62	7.80	0.39	21.92
2	0.44	19.70	44.77	1.51	7.66	0.36	25.07
3	0.70	18.90	27.00	1.34	10.89	0.63	17.82
4	0.38	22.10	58.16	0.86	8.69	0.31	20.93
5	0.75	24.20	32.27	1.16	7.30	0.67	27.55
6	0.79	22.30	28.23	1.55	8.26	0.70	20.02
7	0.58	19.70	33.97	1.84	7.62	0.55	25.00
8	0.45	24.20	53.78	1.53	8.49	0.38	21.45
9	0.45	19.60	43.56	1.81	8.18	0.38	26.43
10	0.43	18.60	43.26	0.98	9.16	0.35	24.21

[a.] Sample designation is as indicated in Fig. 1.

With regard to smoke chemical indicators, the highest tar content was found in the sample from Bogolin micro region (27.55 mg/cig), followed by those from Hvostyane, Ablanitsa and Zhizhevo (26.43 mg/cig, 25.07 mg/cig and 25.00 mg/cig, respectively), with no significant differences between them, and the lowest tar content – in the tobacco from Godeshevo (17.82 mg/cig). Smoke nicotine levels were reasonably low (0.31-0.70 mg/cig), corresponding to the low nicotine in the leaf material.

The results obtained for the nicotine content were considerably lower than those presented in the studies by [11] for other Krumovgrad varieties and by [3] for Xanthi tobacco, but were in full agreement with the data found in [9] for Izmir type tobaccos and in [10] for Prilep tobacco. The reducing sugars content in the examined tobaccos from ecotype Krumovgrad were very close to that reported by [9, 10], but higher than the results obtained in [3, 5, 11]. These deviations confirm the significant influence of the variety, as well as that of the producing region and crop year conditions, on the shaping of the chemical composition of the tobacco type.

3.2 Rating of tobacco by leaf visual quality

The results from the expert assessment of leaf visual quality (based on the individual ranking matrix of each expert) of the tobaccos produced in the ten micro regions of the Nevrokop region (Krumovgrad ecotype, Krumovgrad 90 variety) are presented in Table 2.

The data showed significant (reliable) differences between the compared tobaccos (W=0.52), with the best leaf quality attributes found in the sample from micro region Ablanitsa (rank 1), followed by the ones from Kornitsa, Furgovo, Debren Valkosel, Godeshevo, Zhizhevo, and Bogolin, while the two lowest ranks in that descending order were obtained by the samples from Hvostyane and Slashten.

Table 2. Rating by leaf visual quality of Oriental tobaccos

Expert No	Sample No [a]									
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
1	5.5	3	5.5	10	7	1	8.5	8.5	4	2
2	2	4.5	6	10	7.5	2	7.5	9	2	4.5
3	2	1	6.5	10	8	6.5	4.5	4.5	9	3
4	5	1	2.5	10	7.5	5	7.5	5	9	2.5
5	5	1.5	7	9.5	5	1.5	5	3	9.5	8
6	3.5	1	8	9.5	3.5	6	3.5	3.5	9.5	7
∑*Xij*	***23***	***12***	***35.5***	***59***	***38.5***	***22***	***36.5***	***33.5***	***43***	***27***
Rank	**3**	**1**	**6**	**10**	**8**	**2**	**7**	**5**	**9**	**4**

[a.] Sample designation is as indicated in Fig. 1.

3.3 Rating of tobaccos by smoke sensory characteristics

The results from the assessment of smoke sensory characteristics in the smoking tests of the samples (based on the individual ranking matrix of each panelist) are presented in Table 3.

When comparing the tobaccos in terms of smoke sensory properties, the best evaluated was the sample from Furgovo micro region (rank 1), followed in descending order by those from Ablanitsa, Hvostyane, Debren, Godeshevo, Bogolin, and Kornitsa (the latter three being undistinguishable, sharing ranks 6 to 8), while the last three ranks were obtained by the tobaccos from Zhizhevo, Slashten and Valkosel. The significance and unanimity of the rating order was statistically validated (W=0.88; 95% probability level).

Table 3. Rating by smoke sensory characteristics of Oriental tobaccos

Expert No	Sample No [a]									
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
1	1	2	7	9	7	7	5	10	3	4
2	1	2	5.5	10	5.5	7	8	9	3.5	3.5
3	1	3	7.5	9	6	7.5	4.5	10	2	4.5
4	1	2	5	9	7.5	3	7.5	10	5	5
5	1	2	5.5	10	5.5	7	8	9	3.5	3.5
∑*Xij*	***5***	***11***	***30.5***	***47***	***31.5***	***31.5***	***33***	***48***	***17***	***20.5***
Rank	**1**	**2**	**6**	**9**	**6**	**6**	**8**	**10**	**3**	**4**

[a.] Sample designation is as indicated in Fig. 1.

3.4 Complex evaluation of tobacco quality

As described in the Materials and methods section, the ranking of tobaccos according to their chemical indices accounted for the correlation of the respective index with tobacco quality (and, correspondingly, with the sensory attributes upon smoking). Leaf nicotine content was graded according to its absolute values, i.e. the highest value achieved rank 1, and so on. Reducing sugars were graded against the 10-16% range, accepted as optimal for Oriental tobacco, and all increasing (or conversely, decreasing) values outside that range gave the samples correspondingly lower ranks. The same approach was adopted to rate the reducing sugars/nicotine ratio, against an optimal range of 6-10. Regarding tar (mg/cig) and its negative relation with smoke quality, the ranking was done in the order from minimal to maximal values, i.e. the lowest tar value was given rank 1. The results from the evaluation of leaf visual quality and smoke sensory characteristics (i.e. the respective ranking orders) were transferred directly. The obtained quality index, reflecting the relative weight of each indicator, could be regarded a complex expression for the quality of the tobaccos in the study.

The complex rating of the studied Oriental tobacco samples (ecotype Krumovgrad, variety Krumovgrad 90, produced in 10 distinct micro regions of Nevrokop region) is presented in Table 4.

The results showed that in the complex quality assessment procedure the best-rated was the tobacco from micro region Godeshevo, followed by that from Kornitsa and Furgovo, after which in descending order the tobaccos from Ablanitsa, Debren, Bogolin, Zhizhevo, and Hvostyane, and in the last places – those from Slashten and Valkosel.

Table 4. Complex rating of Oriental tobaccos from Krumovgrad ecotype

Criteria	Sample rank [a]										CI[b]	Quality indices and rating of samples									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Nicc, %	9	9	3	9	2	1	4	9	9	9	0.20	1.80	1.80	0.60	1.80	0.40	0.20	0.80	1.80	1.80	1.80
RSd, %	4.5	4.5	2	7.5	9.5	7.5	4.5	9.5	4.5	1	0.12	0.54	0.54	0.24	0.90	1.14	0.90	0.54	1.14	0.54	0.12
RS/Nic	5	8	1	9	3	2	4	10	6.5	6.5	0.18	0.90	1.44	0.18	1.62	0.54	0.36	0.72	1.80	1.17	1.17
Tar, mg/cig	5	7.5	1	2.5	10	2.5	7.5	4	9	6	0.10	0.50	0.75	0.10	0.25	1.00	0.25	0.75	0.40	0.90	0.60
Leaf quality	3	1	6	10	8	2	7	5	9	4	0.15	0.45	0.15	0.90	1.50	1.20	0.30	1.05	0.75	1.35	0.60
Smoking quality	1	2	6	9	6	6	8	10	3	4	0.25	0.25	0.50	1.50	2.25	1.50	2.00	2.50	2.50	0.75	1.00
Quality index												***4.44***	***5.18***	***3.52***	***8.32***	***5.78***	***4.01***	***6.36***	***8.39***	***6.51***	***5.29***
Rating												**3**	**4**	**1**	**9**	**6**	**2**	**7**	**10**	**8**	**5**

a. Sample designation is as indicated in Fig. 1.
b. CI – Coefficient of importance.
c. Nic – Nicotine, %.
d. RS – Reducing sugars, %.

4 Conclusion

The technological assessment of the quality profile of Oriental tobacco of ecotype Krumovgrad (Basma variety group) produced in the Nevrokop region and marketed in the Republic of Bulgaria for the 2019 crop gives us the reason to summarize that there were significant differences in cured leaf quality characteristics (chemical, visual and sensory) between the tobacco samples representing the same variety and crop year (Krumovgrad 90 variety; crop 2019) but grown in different areas, thus emphasizing once again the effect of soil and environmental conditions in tobacco production:

- The analysis of the results for the chemical quality traits revealed variations between the producing micro regions, as well as a misbalance in the reducing sugars/nicotine ratio in the studied tobaccos of 2019 crop year.
- In terms of cured leaves visual quality the best rated was the tobacco from Ablanitsa, followed by those grown in Kornitsa, Furgovo and Debren micro regions, with statistically significant difference between the samples.

- The assessment of the tobaccos by smoke sensory characteristics showed the best rating (statistically valid) for the sample from Furgovo, followed by those from Ablanitsa, Hvostyane and Debren micro regions.
- The complex assessment of the quality profile of the examined tobaccos, based on their grading in each of the above aspects of leaf quality, was as follows: the best rated was the tobacco produced in Godeshevo micro region, followed by those from Kornitsa, Furgovo and Ablanitsa.

The data obtained could be useful from the point of view of the technological processing of cured tobacco leaves and the objective of obtaining uniform batches of Krumovgrad ecotype tobacco within the commodity segment.

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