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INVESTIGATION ON THE BURNING PROPERTIES OF BURLEY TOBACCO GROWN IN DIFFERENT REGIONS OF BILGARIA

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INTRODUCTION

Tobacco is a raw material which growing and processing is focused on accomplishing tobacco products with specific consumer characteristics. CAMPBELL J. (3) emphasizes that the present-day evaluation of tobacco calls for a differentiation between quality and usability. Tobacco usability refers to the formation of agro-technical, physical, chemical, smoking and technological properties that are acceptable to both the producer and the customer. Usability incorporates two key elements - the first related to the processing efficacy (like lamina/stem ratio, leaf texture, shatter resistance, elasticity, filling power) and the second determining the smoking perception (leaf chemical composition - mostly with respect to nicotine and soluble carbohydrates; effect of filtration and ventilation; burning properties; pesticide residues, etc.). In his discussion on market problems facing broad-leaf tobaccos in Bulgaria, STAYKOV P. (13) points out that in every market situation the evaluation of a tobacco variety is to be done in its whole complexity. Customers' approach is definitely individual depending greatly on the exact purpose of every tobacco stock (i.e. taking into account tobacco usability).

As an ingredient of many cigarette brands Burley tobacco distinguishes itself by its porous leaf structure, high cigarette output and excellent burning rate - characteristics that are shaped by the biological heritage of the type and the curing technology (5, 12). In many Burley producing countries, there had been a clear understanding about the correlations between the variable and constant factors that affect tobacco characteristics (4), and these correlations served as a basis for the development of national programs for guaranteeing the minimal quality and the good usability of the raw material (3).

The process of tobacco burning depends largely on the structure and the chemical composition of the leaves. Lower leaf density combined with higher content of mineral salts, especially potassium and calcium, favors combustibility, while raised chlorine levels execute a definite negative impact (1). NIKOLOVA M. (11) studies the role of potassium on the formation of tobacco quality and finds out that optimal potassium fertilization results in favorable leaf coloration, good physical characteristics (elasticity, burning) and satisfying smoking properties. The author confirms the fact that fertilization with potassium chloride considerably deteriorates tobacco quality with regard to hygroscopicity, protein content, smoking character, and odor. In the research work of BONEVA-IVANOVA A. (10) additional information about the impact of inorganic constituents and some physical indexes on the burning properties of tobacco leaf is found. YAMAMOTO T. et al. (8) and KAMESWARA RAO B.V. et al. (6) demonstrate that considerable concentrations of potassium (especially in the form of organic salts) strongly alter the temperatures within the burning zone of the cigarette, thus defining the reduced yield of tar, nicotine and CO observed. The positive effect of organic potassium on the burning capacity of tobacco is underlined, too, by PIRIOU N. (7) and BASKEVITCH N. (2), who suggest regression models for the prediction of burning rate and tar yield for different types of tobacco.

The investigation of ZAHEDIE R. and MOGHADDAM S. (9) defines the effect of potassium to chlorine ratio on the burning capacity of cured tobacco leaves. It is summarized that tobacco leaves demonstrate poor burning rate at

K/Cl < 1; at values within the range 1 - 4 tobacco has low burning rate and when values exceed 5 (5-20) tobacco is with intensive burning.

These were the grounds to aim this study at the investigation on the burning properties of Burley tobacco grown in different Bulgarian regions, as a basis for its usability assessment.

MATERIALS AND METHODS

Three varieties of Burley tobacco were investigated - Burley 1317, Burley 1000 and Burley 21, crop 2004, grown in different production regions of South and North Bulgaria, as follows:

South Bulgaria regions:

Haskovo - villages: Yabalkovo and Kroum;

Stara Zagora - villages: Mednikarovo, Mogila, Iskritza and Zimnitza;

Kazanluk - villages: Dolno Sahrane;

Yambol - villages: Zimnitza and Drazhevo.

North Bulgaria regions:

Vidin - villages: Razgrad;

Kozloduy - villages: Glozhene, Butan and Harletz;

Pleven - villages: Koinare and Yasen;

Isperih - villages: Slivo Pole;

Dulovo - villages: Tzar Samuil, Nova Cherna, Pravda, Professor Ishirkovo, Belitza.

In order to assess its potential, we selected for analysis the experimentally grown in the Yambol region GR variety (labeled as Yambol - GR).

Tobacco samples from each micro-region (village) were built by selecting leaf material from stalk positions B (lugs) and C (cutters), which are known as shaping the characteristic quality of the type and comprising mainly of first grade leaves. Tobacco samples from each village were carefully blended. Corresponding to the percentage share of tobaccos produced in the respective villages in accordance with the national quotas for 2004 crop year, representative analytical samples for each region were designed, thus expressing the "average" quality of the tobaccos from the studied region. Aiming at a more complex characterization of the overall quality of the type, we carried out proportional blending of the so-prepared samples, individually for North and South Bulgaria, in that manner forming two additional samples for analysis - North Bulgaria blend and South Bulgaria blend.

Basic parameters affecting tobacco combustibility were determined, as follows:

Physical indexes:

- Free burn (min) and linear burning rate (mm/min) - by ISO 3612 (14);

Chemical indexes:

Potassium (as K_2O), % - according to the Bulgarian State Standard (BDS) 17365-94 (14);

Chlorine, % - by continuous flow analysis (a method of the ITTP, 1995), on an auto-analyzer AA II C, "Technicon", USA;

Mg (as MgO), %; Ca (as CaO), %; Na (as Na2O), % - the protocol of sample preparation followed BDS 17365-94 (14) and the reading of the data was done by atom-absorption spectroscopy (AAS) on a Spectra AA 220 apparatus, "Varian", Australia.

All analytical data presented are mean values from two parallel samples in twofold repetition.

The assessment of the burning properties is accomplished by the implementation of a number of indexes ("ratios of burn"): the indexes of Nessler, De Bonis, Sastry and Kurup (var. I and II), which have been defined in the literature review as the most appropriate for expressing the role of basic inorganic components on the burning characteristics of Burley tobacco.

ANALYSES AND DISCUSSION

The results achieved for the free burn and the linear burn rate of the samples are presented in Table 1. The indicator free burn (expressed as the time required for the uninterrupted smolder of a pre-marked cigarette length) took values within the range from 9.79 min to 12.06 min for the entire bulk of samples. The linear burn rate (in mm/min) varied between 3.32 and 4.09 mm/min. The best burning properties, according to both parameters, were expressed in tobacco samples from the regions of Yambol, South Bulgaria blend, Stara Zagora, Pleven, Kazanluk and Yambol - GR.

The results from our study showed that tobaccos originating from South Bulgaria regions distinguished themselves by better burning properties.

Table 1 - Free burn and linear burning rate
Таб.1 Слободно горење и брзина на горењето

Region Реон	Free burn, Слободно горење min	Burning rate, Брзина на горењето mm/min
Vidin	11.02	3.63
Kozloduy	11.97	3.34
Pleven	10.40	3.85
Isperih	11.00	3.64
Dulovo	12.06	3.32
North Bulgaria blend	11.04	3.62
Haskovo	11.55	3.46
Stara Zagora	9.93	4.03
Kazanluk	10.44	3.83
Yambol	9.79	4.09
South Bulgaria blend	9.91	4.04
Yambol - GR	10.67	3.75

It has long been known that good combustibility of tobacco is a major quality index, as no revealing of smoking potential is possible without a satisfactory burning. Moreover, the process of tobacco burning outlines to a great extent the yield of tar, CO and other components of tobacco smoke defined as harmful to humans. Considerable part in the manifestation of burning character is played by the chemical composition of tobacco, especially with respect to its potassium and chlorine content and the quantitative ratio between the two elements. Literature review found a number of authors suggesting the application of various indexes ("ratios of burn") that reflect the impact of the major inorganic constituents on the combustibility of Burley tobacco.

Table 2 presents the results about the content of tobacco components that are known to correlate with combustibility, as well as the calculated values of the four indexes of burn chosen as the most suitable for the purpose of the study.

With respect to chlorine levels, the deviations were within relatively narrow limits for the entire bulk of tobacco samples - from 0.06 % for Kazanluk region to 0.84 % for Kozloduy region. The common trend was that lower chlorine levels characterized the regions of South Bulgaria. North Bulgaria blend had higher chlorine levels than South Bulgaria blend. Potassium content varied within a broader range - from 1.00 % for Pleven region to 3.30 % for Yambol. A reverse trend was found in potassium content distribution - higher levels were determined for the samples from South Bulgaria regions. Between South Bulgaria blend and North Bulgaria blend the differences in potassium levels were significant - 1.78 % opposed to 3.22 %, respectively.

The results achieved for potassium to chlorine ratio (the index of Nessler) and the review of the published data on the subject, allowed for the following grouping of tobaccos to be made:

1st group - tobaccos with poor burning characteristics - Kozloduy and Pleven;

2nd group - tobaccos with good burning capacity - the rest of the regions, among which the best burning properties according to this specific index were demonstrated by the samples from the regions of Kazanluk, Haskovo and Yambol-GR.

The greatest values of the index of De Bonis were calculated for the samples from the region of Haskovo, followed by Yambol, Kazanluk and South Bulgaria blend.

The values obtained for the index of Sastry and Kurup (var. I) allowed for the following sequence of regions to be made (in descending order) - Yambol, Stara Zagora, South Bulgaria blend, Kazanluk, Yambol-GR and Haskovo.

According to the results from the determination of the index of Sastry and Kurup (var. II) the best burning properties were associated with the regions of Yambol, Stara Zagora, South Bulgaria blend, Kozloduy and Vidin.

As it might be seen from the data listed above, some variations did exist in the ranking of tobaccos from the different regions under study, according to the specific criteria applied, as each of them reflected the influence of different chemical constituents of tobacco dry matter. On

the grounds of the results achieved from the application of all indexes of burning, the samples were awarded corresponding ranks and, after eliminating the greatest deviations, statistical analysis was performed with Fisher's F-test. The ranking of tobaccos was found statistically significant at =0.05. So, according to the values of the indexes of burning and the ranks awarded, the samples from Burley tobacco grown in the different regions of Bulgaria were arranged in the following groups (in the order of burning properties' decline):

Group I - Yambol and South Bulgaria blend;

Group II - Kazanluk and Haskovo;

Group III - Yambol-GR and Stara Zagora;

Group IV - North Bulgaria blend, Vidin, Isperih and Dulovo;

Group V - Kozloduy and Pleven.

Table 2 - Chemical composition of tobacco and indexes of burning
Таб. 2 Хемиски состав на тутунот и индекси на горење

Region Реон	Chlorine, %	K_2O, %	MgO, %	CaO, %	Na_2O, %	Index of Nessler [1)]	Index of De Bonis [2)]	Index of Sastry and Kurup I [3)]	Index of Sastry and Kurup II [4)]
Vidin	0.17	1.35	0.84	4.55	0.0098	7.94	5.79	0.48	1.61
Kozloduy	0.84	1.30	0.73	5.44	0.0076	1.55	4.27	0.38	1.62
Pleven	0.41	1.00	0.76	4.61	0.0149	2.44	4.73	0.30	1.39
Isperih	0.12	1.58	0.80	3.92	0.0061	13.17	5.94	0.50	1.39
Dulovo	0.14	1.16	0.75	4.73	0.0106	8.29	6.54	0.36	1.47
North Bulgaria blend	0.26	1.78	0.76	4.69	0.0067	6.85	6.30	0.53	1.58
Haskovo	0.11	2.94	0.54	3.53	0.0098	26.73	9.81	0.84	1.59
Stara Zagora	0.45	3.24	0.65	2.99	0.0094	7.20	5.62	1.07	1.70
Kazanluk	0.06	2.95	0.76	3.11	0.0072	49.17	7.33	0.93	1.54
Yambol	0.18	3.30	0.57	2.71	0.0085	18.33	7.92	1.19	1.79
South Bulgaria blend	0.18	3.22	0.70	3.24	0.0070	17.89	7.28	1.03	1.69
Yambol - GR	0.13	2.94	0.76	3.18	0.0062	22.62	6.83	0.89	1.50

[1)] $Index\ of\ Nessler = \frac{K_2O}{Cl}$

[2)] $Index\ of\ De\ Bonis = \frac{K_2O + CaO}{Cl + Na_2O + MgO}$

[3)] $Index\ of\ Sastry - Kurup\ I = \frac{K_2O}{Total\ Nitrogen + Cl}$

[4)] $Index\ of\ Sastry - Kurup\ II = \frac{K_2O + CaO}{MgO + Total\ Nitrogen + Cl}$

CONCLUSIONS

The assessment of the burning properties of Burley tobaccos from different regions of production established better combustibility for the tobaccos from South Bulgaria. The regions were classified into five groups by the manifestation of the burning properties of the tobacco grown there, among which Yambol and South Bulgaria blend were distinguished as having the best characteristics.

In conclusion, the results from our study are informative from a decision-making point of view, considering the usability of tobaccos from different Bulgarian regions and the options for their blending.

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ИСПИТУВАЊЕ НА СВОЈСТВАТА НА ГОРЕЊЕ НА БЕРЛЕЈСКИОТ ТУТУН ОДГЛЕДУВАН ВО РАЗЛИЧНИ РЕОНИ ВО БУГАРИЈА

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РЕЗИМЕ

Испитувани се слободното горење (мин) и линеарното горење (mm/мин) на берлејски тутуни од различни производни реони. Тутунските проби се анализирани во однос на нивото на одредени минерални состојки за кои се знае дека имаат влијание врз карактеристиките на горење на тутунот. Пресметани се вредностите на различни показатели на горењето. Испитуваните тутунски проби се класифицирани на пет групи, врз основа на манифестирањето на нивните карактеристики на горењето.

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