BOOK OF PROCEEDINGS

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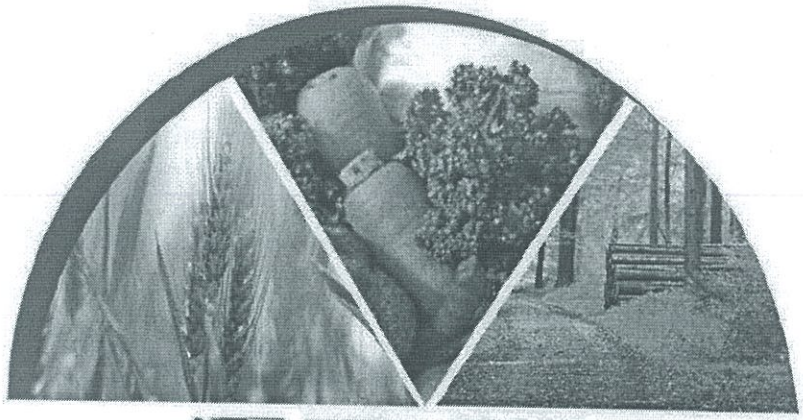

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EFFECT OF DRYING MODE ON THE CHANGES OF VIRGINIA TOBACCO TYPE CHEMICAL COMPOSITION

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Abstract

Virginia type of tobacco is used in the highest percentage in the mixture for making cigarettes. Important factors for the formation of quality features of Virginia are environmental conditions of manufacturing but preferably the well regulated drying process. Drying of these tobacco types is performed in special dryers with controlled conditions (flue curing-FC). Since the price of energy source for drying process participate the greatest deal in total expenses during the production and processing of tobacco, the scope of the experiment was to determine the possibilities of drying tobacco in a natural condition (air curing-AC). Material for research the first-class middle leaves of Virginia tobacco type, variety Heveshi - 9, were produced in Vojvodina area (Srem - Maradik), vintage 2015.

The experimental results showed that the way of drying affects the appearance and color of leaves, chemical characteristics of tobacco and duration of the drying process. Considerable differences of chemical composition between flue curing and air curing tobacco were found as follows (% in dry matter): 2.03 and 2.25 (nicotine), 1.80 and 2.73 (total N), 0.87 and 2.06 (protein N), 5.46 and 6.60 (total proteins), 19.39 and 1.96 (reducing sugars), 11.61 and 15.43 (ash), 1.48 and 8.91 (sand), 5.19 and 5.92 (pH), respectively. The leaves dried in natural condition (AC) had dark color (dark Virginia) and rough nervature. Although drying in a natural condition brings cost savings in energy, the process is longer by 24 days comparing to flue curing.

Keywords: *drying, flue-curing (FC), air curing (AC), Virginia, chemical composition*

Introduction

First steps in production of Virginia in the Republic of Serbia were taken in1960's (Popović, 2000). More intensive production began in the eighties and has continued until today.

Virginia type of tobacco contains large leafs; it has lemon yellow to golden yellow color, specific flavor and pleasant tobacco smell. This type of tobacco represents a very important component in a blend for the cigarettes. Due to the high content of soluble carbohydrates, Virginia tobacco is the main precursor for the components which contribute to the taste of tobacco smoke. In addition, this type of tobacco has good cutting properties, which makes it a binding material inside the cigarette and makes it prevent falling other components out of cigarette. Mentioned properties are influenced either by genetics or the curing method. Virginia tobacco type, due to its characteristics, is used in the preparation of high quality cigarette blends of American type (in which may comprise up to 60% of mixture), and exclusively as a material for the cigarettes of English (the Virginia type).

Due to increasing yearly demands for this tobacco type on both, domestic and foreign markets, it is important to determine processing parameters influencing significantly on obtaining the raw material of highest possible quality. The significance of Virginia tobacco type resembles in technological properties such as voluminous and combustion properties, percent of fibre and fractions, but first of all in its taste, which makes this tobacco

indispensable raw material in the production of cigarettes (Radojičić, 2016). Based on data of Statistical Office of the Republic of Serbia, the total yield of Virginia tobacco in year 2014 was 9341 tons, in year 2015 it was 8776 tons (Statistical Yearbook of the Republic of Serbia, 2016).

Due to morphological characteristics, Virginia tobacco type has large leaves. In accordance with technological classification it belongs to FC types of tobacco, i.e. type of tobacco that is dried under controlled conditions (in special dryers), in which drying parameters can be regulated.

Tobacco production requires a lot of work from the beginning of seeding, transplanting, cultivating of the crops, harvesting stringing, drying and delivering of yellow leaves. The quantity and the quality of the leaf, after drying, affect its use value. Drying tobacco is often crucial operation that defines quality, and hence the selling price. For all mentioned reasons it is important to apply the optimal drying regime, which for Virginia tobacco type is drying in a stream of conditioned air (Popović, 2000). However, for this method of drying, the largest shares in production expenses are energy costs. They comprise from 26 to 28% of the total costs (Radojičić, N. 2011), which is understandable due to high price of energy sources and high consumption per unit of product ($1m^3$ of natural gas is consumed for drying of 1 kg of tobacco). Besides, the high price of the dryer is also large expense for the middle size producer. Therefore the scope of this work was to examine the possibilities of other methods of curing Virginia type of tobacco.

In developing countries, due to lack of funds for the purchasing of energy sources, drying in natural conditions (in the sun or in the shade) are widely spread. It is known that Virginia tobacco type can be dried in the sun. Under conditions of this type of drying, the leaf has darker color, and they are mainly used for making the mixture for a pipe or cigar (Voges, 1984). However, the literature review authors found no data about air curing of Virginia tobacco type. Therefore, the aim of this experiment was to determine the possibilities of drying the Virginia in the natural condition (AC), and to compare the chemical properties to properties of a standard tobacco dried in the special dryers. These results may indicate the possible use value of this raw material relevant to the manufacturers.

Materials and methods

As a material in this work the first-class leaves of medium insertion of Virginia tobacco type, the variety Heveshi - 9, produced in the Vojvodina area (Srem - Maradik), of harvest year 2015 were used. The leaves are harvested at the stage of technological maturity, strung and dried in two different ways:

- The first sample was dried in the special dryer T - 42, under a stream of heated air, in a controlled condition (FC).
- The second sample is dried under the influence of the ambient air, in the shade, without the influence of additional sources of heat (AC).

Chemical parameters were determined by methods described in sources as follows: nicotine (ISO, 2881, 2007), total nitrogen, protein nitrogen and total proteins (Radojičić, 2011), reducing sugars (SRPS E.P3.115, 1965), ash (SRPS E.P3.117, 1965), sand (ISO 2817, 2007) and pH (SRPS E.P3.116, 1965).

The experiment was carried out in Maradik, municipality of Inđija. Analysis of chemical quality parameters of dried leaves was carried out in the Tobacco Laboratory, Faculty of Agriculture, and University of Belgrade. Methods used are given in Table 1. All analyzes were done in five repetitions. Data obtained from the experiments were analyzed and the results were expressed as mean value ± SD. Statistics were performed using SPSS 17.0 t - test to compare differences between samples.

Results and discussion

Results showed that the applied methods of drying affect the color of dried leaves, the changes in chemical characteristics of tobacco and duration of the drying process.
- The leaves dried in a special dryer T- 42with heated air, under controlled conditions had a light yellow color (bright Virginia) with a fine and thin nervature.
- The leaves dried in a natural condition (AC) had dark color (dark Virginia), rough nervature.
- The drying process under controlled conditions lasted for 127 hours (6 days) and the air curing process lasted for 30 days.

Table 1 shows the mean values of the studied chemical characteristics of the Virginia tobacco type, dried in two different ways.

Table 1. Chemical composition of Virginia tobacco type (% in dry matter)

Drying	Nicotine	Total nitrogen	Protein nitrogen	Total proteins	Reducing sugars	Ash	Sand	pH
Flue curing	2.03	1.80	0.87	5.46	19.39	11.61	1.48	5.19
Air curing	2.25	2.73	2.06	6.60	1.96	15.43	8.91	5.92

* pH in units

Based on the results shown in Table 1, it is clearly seen that the mean values of six parameters observed (nicotine, total nitrogen, protein nitrogen, total proteins, ash, and sand) are higher in tobacco dried in natural condition (AC) comparing to FC. In contrast, the content of reducing sugars and the pH value are lower for tobacco, dried in natural conditions (AC).

Statistical comparison of the chemical characteristics of tobacco in relation to the method of drying is presented in Tables 2 and 3.

Based on the ANOVA test, it can be concluded that there is a statistically significant difference between the mean values of the chemical composition depending on the applied drying process. In terms of the content of nicotine and pH value there is significant difference at the 0.05 level, while for all other components difference is significant at the 0.01 level.

Among samples, the lowest difference was observed in the content of nicotine (0.22). The difference in the content of total nitrogen is 0.93. This is indication that physiological strength and sharpness of tobacco smoke dried in a natural condition (AC) is different comparing to FC. Beljo et al. (1998) reported that the content of total nitrogen in the Virginia tobacco can be in the range between 1.53%-2.38%. Based on the values shown in Tables 1 and 3 it can be concluded that drying in natural conditions (AC) yields the increased value of total nitrogen. As drying process influences the changes in the content of total proteins in leaf, it means that drying is a critical step in processing. In the dark Virginia content of total proteins is increased by 1.41 compared to bright Virginia. It is considered that the optimum value for the highest quality of flue cured tobacco between 4.5%-5.5% (Stanković, 2000). The data from Tables 1 and 3 indicate more extensive degradation of total proteins affected by drying in a stream of heating air.

Table 2. Descriptive Statistics

Group Statistics					
	Sample	N	Mean	Std. Deviation	Std. Error Mean
Nicotine	Virginia bright	5	2.0300	.03606	.02082
	Virginia dark	5	2.2533	.04726	.02728
Total nitrogen	Virginia bright	5	1.8033	.04509	.02603
	Virginia dark	5	2.7333	.04933	.02848
Protein nitrogen	Virginia bright	5	.8700	.03000	.01732
	Virginia dark	5	2.0633	.04509	.02603
Total proteins	Virginia bright	5	5.4600	.04583	.02646
	Virginia dark	5	6.6033	.00577	.00333
Reducing sugars	Virginia bright	5	19.3933	.44433	.25654
	Virginia dark	5	1.9567	.03512	.02028
Ash	Virginia bright	5	11.6133	.03215	.01856
	Virginia dark	5	15.4333	.16442	.09493
Sand	Virginia bright	5	1.4833	.04933	.02848
	Virginia dark	5	8.9133	.05033	.02906
pH	Virginia bright	5	5.1900	.05568	.03215
	Virginia dark	5	4.9200	.04359	.02517

Table 3. Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Nicotine	.416	.554	-6.508	4	.003*	-.22333	.03432
Totalnitrogen	.153	.716	-24.102	4	.000**	-.93000	.03859
Protein nitrogen	.420	.552	-38.163	4	.000**	-1.19333	.03127
Total proteins	5.729	.075	-42.875	4	.000**	-1.14333	.02667
Reducing sugars	11.060	.029	67.758	4	.000**	17.43667	.25734
Ash	7.613	.051	-39.494	4	.000**	-3.82000	.09672
Sand	.016	.906	-182.607	4	.000**	-7.43000	.04069
pH	.143	.725	6.614	4	.003*	.27000	.04082

** p< 0.01
*p< 0.05

The most prominent difference among samples is in the content of reducing sugars. For bright Virginia type, sugar content is 19.39%, while for dark it is only 1.96% (Table 1). The difference of 17.44 (Table 3) shows that longer drying process caused an almost complete breakdown of the reducing sugars (Brown, 1990). According to Dixon (2000), pH value for Virginia tobacco is between 5 and 6. Based on values in Table 1, the pH value for the sample of bright Virginia was lower (5.19), in comparison with the sample of dark Virginia (5.92). This result is a direct consequence of the extremely large reduction of reducing sugars compared to a slight increase in the content of nitrogen compounds. Alteration of these parameters indirectly causing a sense of sharpness and a stronger smoke during inhalation.
The difference in ash content is 3.82 (Table 3). A sample of bright Virginia has proportionately smaller amount of mineral matter comparing to the dark Virginia, which means that the decomposition of organic matter during drying in a natural condition (AC) was more complete. The resulting ash content in both experimental samples was within the limits for Virginia type of tobacco (Alić-Džemidžić et al., 2002; Radojičić, 2016). Sand content was significantly higher in the dark Virginia (difference is 7.43), almost beyond all known

literature data. It is assumed that the sample had significantly more impurities because drying in an unprotected area.

Conclusion

Based on the results of this research which aim was to figure the possibilities of curing Virginia tobacco type under natural conditions (AC) it can be concluded:
Significant differences in the duration time of the drying process exist, as well as difference between sensory and chemical characteristics among Virginia tobacco type dried in a conventional manner (in a special dryer) compared with tobacco dried in natural condition (AC).
Although drying in a natural condition (AC) brings cost savings in energy, the process is longer by 24 days compared to drying in a special dryer. Leaves dried in special dryers under controlled conditions had light yellow color (bright Virginia) with a fine and thin nervature, whereas those dried in natural condition had dark color (dark Virginia) and rough nervature.
Nicotine, total nitrogen, protein nitrogen, total proteins, ash, and sand were higher in tobacco dried in shadow (AC), but reducing sugars and pH value were smaller. As a general conclusion can be observed that drying of Virginia in natural condition is completely changing its sensory and chemical properties, which is the reason of approaching to the characteristics of dark tobacco.

Acknowledgments

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