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Research Article

The Effects of During Sun-Cured Period on the Some Chemical Composition Changes of Oriental Tobacco

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Abstract

Tobacco curing is a complex combination of parallel physical and biochemical processes in green tobacco leaves. The aim of this study is to find the effect of the yellowing stage in the curing process on the change of basic chemical values of nicotine and sugars in Bulgarian varieties and newly selected lines oriental tobacco in the Plovdiv and Macedonia tobacco regions. The study is carried out in Tobacco and Tobacco Products Institute, Markovo. Line 27, Line 94, Line 275, Harmanli 134, Kozarsko 339, Plovdiv 7, Plovdiv 187, Plovdiv 380, Dupnitsa 160 and Dupnitsa 733 were investigated, harvest 2016. Each tobacco sample was divided into two groups - yellowed for 48 hours and dried without yellowing. Reducing the nicotine content in tobacco during sun-curing is proven for all studied varieties with exception of Plovdiv 7. The increasing of quantity of soluble sugars in tobacco is high for all studied varieties from both tobacco regions.

Key words: Oriental tobacco, sun-curing, nicotine, sugar

Introduction

Physical and chemical properties of tobacco leaves are the product of the genetic constitution of variety, agricultural practices, soil and nutrients type, weather conditions, harvesting and curing process.

A change in any of the above can cause a significant change in the chemical composition of leaves and thus affect the quality of received raw material (Tso, 1990). Tobacco curing is a complex combination of parallel physical and biochemical processes in green tobacco leaves. Chemical transformations during curing stage are dominated by hydrolytic enzymes. Oxidative reactions also occur but on a comparatively smaller amount. The success of the curing process depends on the degree of leaf maturity, temperature and moisture which control biochemical processes and the rate of dehydration (Abubakar et al., 2000). The main purpose of curing is to reveal and develop the typical quality signs collected in tobacco leaves during their biological development. The natural metabolic changes starting during maturation continue in the phase of yellowing under conditions specific for each tobacco variety. One of the main changes is the decomposition of carbohydrates (mainly starch) in sugars, carbon dioxide and water. Proteins and other nitrogen compounds are also decomposed to simple ones. Some of them are later recombined with the products of carbohydrate decomposition for the formation of products that contribute to the formation of flavour and taste (Anonymous, 2016).

In the stage of yellowing, major chemical changes occur in tobacco composition leading to reduction of the substances causing negative quality indicators (chlorophyll, ash, total nitrogen, etc.) and improvement of quality characteristics of cured tobacco as a finished product for smoking. Chlorophyll degradation and gradual appearance of yellow pigments are the most visible biological changes occurring during yellowing stage. Chlorophyll is gradually decomposed during curing process. The level of chlorophyll decomposition varies depending on temperature. In higher temperatures chlorophyll decomposes faster and its level stabilizes earlier (Abubakar, 2000).

Nicotine is the most typical chemical component of alkaloids in tobacco plants. It determines the physiological effect of smoking which is present only with positive nicotine content in an optimal range (Dimanov and

Masheva 2011). In the process of curing, nicotine decreases by an average of 10-30% due to its oxidation caused by the action of a specific oxidizing system. Nicotine transformation in the process of curing is presented at Figure 1. Decomposition mainly occurs during autolysis in the second curing phase. The degree of decomposition depends on the temperature and moisture characteristics of the curing process and its duration (Chuman, 1977; Gyuzelev, 1983; Leffingwell, 1999; Shi et al., 2008).

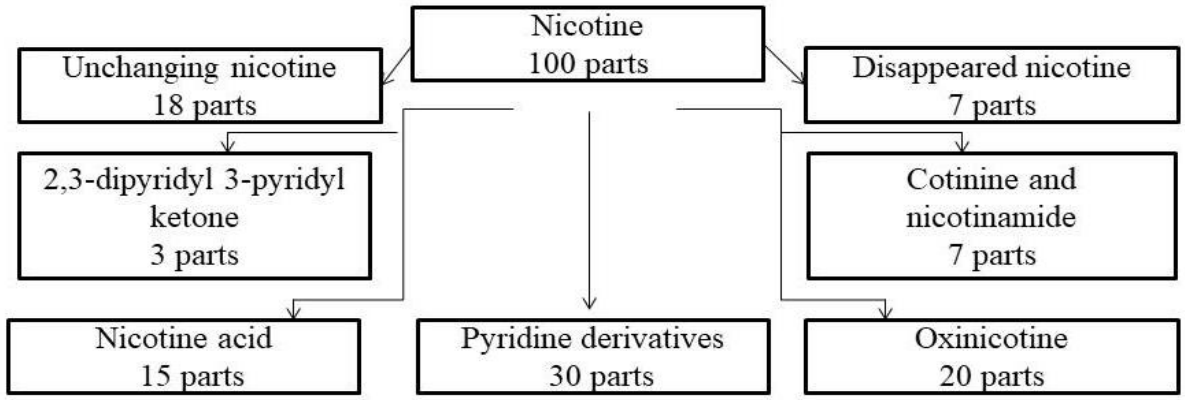

Figure 1. Chemical changing of nicotine during sun-curing period

In the process of curing, carbohydrates undergo significant changes. The nature and degree of such changes depend on the variety, duration off yellowing, method of curing, etc. In the yellowing stage, different carbohydrate types undergo different quantitative and qualitative changes. Greatest changes occur in starch and sucrose. Disaccharides and polysaccharides are hydrolyzed to their constituent monomer units. Starch is hydrolyzed to glucose under the action of the enzyme amylase and sucrose is hydrolyzed to glucose and fructose under the action of the enzyme invertase. (Gyuzelev, 1983; Layten and Nielson, 1999). This is the reason why reducing sugars (glucose and fructose) increase their quantity in the stage of yellowing and then decrease in the middle of the leaf curing period only to stabilize again in the curing of bright leaf tobacco. (Abubakar, 2000).

Curing the stage of the overall technological process when main changes in chemical composition of tobacco occur, thus contributing to the full development of quality characteristics of oriental tobacco. Despite the drop in tobacco production, today this crop still significantly affects the demographic, economic and social problems in many regions of our country. To stimulate the development of the tobacco sector, it is necessary to improve its competitiveness. For this purpose, it is not only necessary to introduce new varieties of oriental tobacco but also to cultivate the varieties typical for each tobacco region. It is necessary to use new technologies for primary treatment and processing of tobacco for the full manifestation of the quality characteristics of each variety.

The main purpose of this study is to find the effect of the yellowing stage in the curing process on the change of basic chemical values of nicotine and sugars in the oriental tobacco varieties in the Plovdiv and Macedonia tobacco regions.

Materials and Methods

Materials

Bulgarian varieties of oriental tobacco and newly selected lines from the Plovdiv and Macedonian tobacco regions - Line 27, Line 94, Line 275, Harmanli 134, Kozarsko 339, Plovdiv 7, Plovdiv 187, Plovdiv 380, Dupnitsa 160 and Dupnitsa 733, harvest 2016 were investigated. Tobaccos were grown in the Experimental field of the village Kozarsko and Experimental station in the town Rila to the Tobacco and Tobacco Products Institute under vegetation period.

Methods

Each tobacco sample was divided into two groups - yellowed for 48 hours and dried without yellowing (control). The nicotine and reducing carbohydrates (sugars) content of all groups was determined in the laboratory complex for testing in the TTPI, Markovo. The content of nicotine and sugars was performed according to international standardized methods:

Nicotine content was determined with autoanalyser Technicon II according ISO15152:2003 (Anonymous, 2003a). The principle of the method consists in rifting cleaving the

pyridine group from the nicotine molecule with cyanogen bromide. Further reaction with aniline in a buffered solution is inthe formation of a yellow-colored compound which is measured colorimetrically at 460 nm.

The content of reducing carbohydrates (sugars) was checked by using autoanalyser Technicon II following the ISO 15154:2003 (Anonymous, 2003b). The content of reducing carbohydrates is based on their ability to reduce potassium ferricyanide to potassium ferrocyanide, whereby the intensity of ferrocyanide staining is reduced. This color decrease in color at 420 nm is directly proportional to the amount of sugars.

Analysis of each sample was performed in triplicate. All results presented were the mean ± SD of at least three independent experiments. Statistical analysis (ANOVA) was carried out with SPSS 16.0 for Windows.

Result and Discussion

The process of curing is one of the main steps in tobacco production system. Its purpose is to bring tobacco leaves to the desired state without damaging the potential quality of dry tobacco. To achieve this, curing must allow the continuation of biological processes in leaves (Tso, 1990) because the chemical changes occur during the curing process. And so, dramatic effects on the cured product (Burton and Kasperbauer, 1985; Shi, 2008). Tobacco samples with different levels of nicotine and sugars were selected and investigated. The content of nicotine in the control varies between 0.55 ± 0.077 Dupnitsa 733 to Line 27 - 1.50 ± 0.021%, which is within the range expected for oriental tobacco (Masheva et al., 2014; Masheva and Kasheva 2016). Nicotine synthesis in tobacco plants is genetically conditioned but its level is strongly affected by nutritional conditions, weather conditions, curing conditions and the conditions of fermentation of raw tobacco (Leffingwell, 1999).

The results for the effect of the yellowing stage in sun curing on the change of nicotine content in tobacco by varieties against reference values (without yellowing of tobacco) are presented in Figure 2. The figure shows that nicotine content in tobacco after curing with yellowing stage significantly decreases as compared with the control of all studied varieties except for the Plovdiv 7 variety. The content of nicotine in tobacco after curing with yellowing stage varies between 0.53±0.007 (Dupnitsa 733) and 1.47 ± 0.020 % (Plovdiv 7 variety). Highest nicotine content reduction is observed for Line 94 (control – 0.91 ± 0.012 %; tobacco with yellowing stage – 0.74 ± 0.010 %) next for the Harmanli 134 (control – 0.79 ± 0.011 %; tobacco with yellowing stage – 0.68 ± 0.009 %) tobacco variety and the lowest one – for the Dupnitsa 733 (control – 0.55 ± 0.007 %; tobacco with yellowing stage – 0.53 ± 0.007 %) variety. The received results confirm the studies of Gyuzelev (1983), which show that nicotine content in the curing stage is reduced by an average of 10% to 30%. Only the Plovdiv 7 variety (control – 1.35 ± 0.019 %; tobacco with yellowing stage – 1.47 ± 0.020 %) showed increase of nicotine content after curing with 48-hour yellowing as compared with the without yellowing of tobacco values. This is most probably due to chemical changes and transformations in contained alkaloids (Abubakar, 2000).

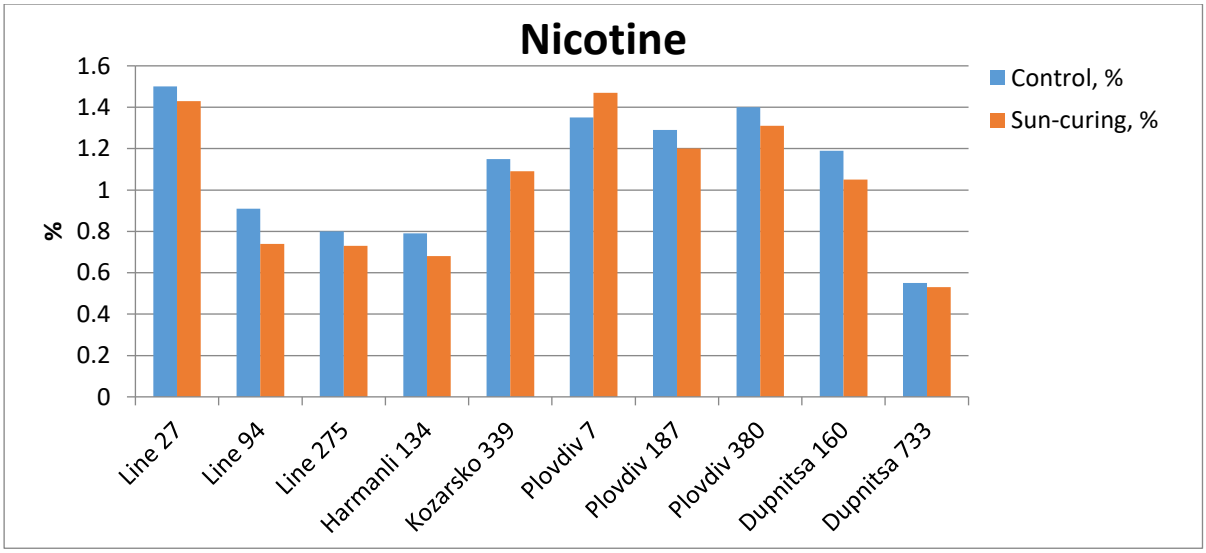

Figure 2. Content of nicotine in tobacco varieties in curing with yellowing stage of tobaccos

The curing method affects the quantity of sugars in cured tobacco leaves. The correct performance of the process leads to the parallel occurrence of basic physical and biochemical processes in green tobacco leaves, leading to the revealing of the main quality signs collected during the tobacco growing period (Weybrew et al., 1984).

In controls the lowest sugars content is characterized by the Harmanli 134 variety (17.10 ± 0.68%) and the highest - Line 275 (22.9 ± 0.91%). which is typical of Oriental tobaccos (Leffingwell, 2001). The data presented in figure 3 show that all studied tobacco varieties have higher content of soluble sugars (monosaccharides) when cured with yellowing as compared with the reference values (controls) because of the decomposition of disaccharides and polysaccharides. The highest increase is observed for the Kozarsko 339 (control – 21.30 ± 0.85 %; tobacco with yellowing stage – 23.70 ± 0.95 %) variety and the lowest for the Harmanli 134 (control – 17.10 ± 0.68 %; tobacco with yellowing stage – 17.40 ± 0.70 %) variety. The content of sugars is typical of Oriental tobaccos (Leffingwell, 2001). Similar results were received by Gyuzelev (1983) who found that starch almost fully disappears in the yellowing stage of curing oriental tobacco but the quantity of soluble carbohydrates more or less tobacco variety and by Weybrew et al., (1984) for the Burley tobacco variety.

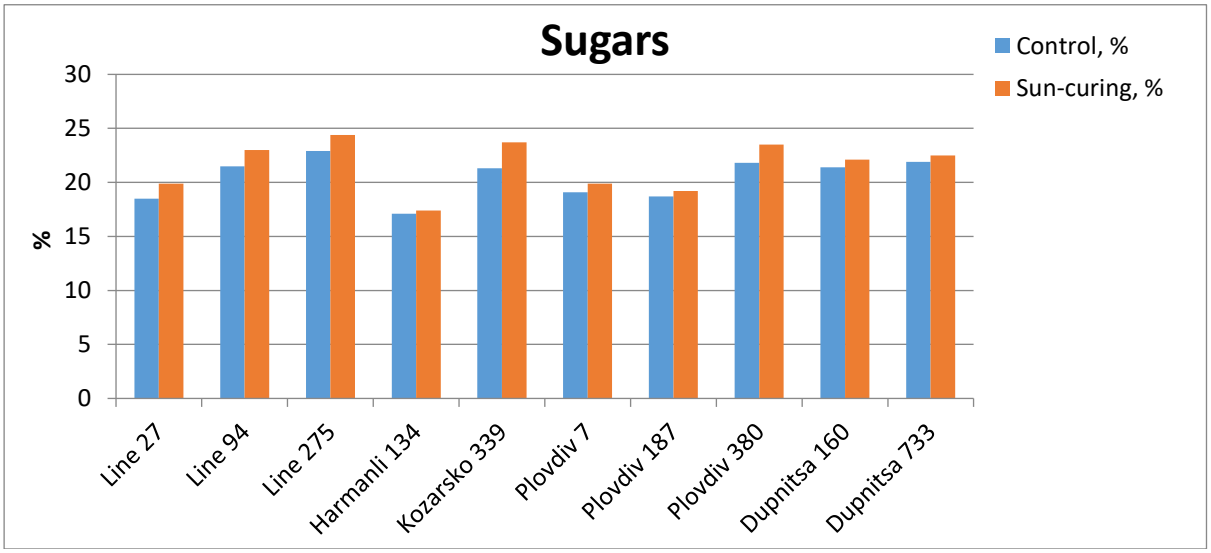

Figure 3. Content of sugars in tobacco varieties in curing with yellowing stage of tobaccos

Figure 4 presented the results of the percentage of variation of the chemical components nicotine and sugars in curing with yellowing stage in the different tobacco varieties. The content of nicotine decreased between 22.97% (Line 94) and 3.77% (Dupnitsa variety 733). It was reported that the content of nicotine in Plovdiv 7 increased by 8.16%.

In all studied varieties there is an increase in the sugar content after sun-curing period yellowing as follows: Kozarsko 339 (10,13%), Plovdiv 380 (7.23%) and Line 27 (7.04%) and the lowest in Harmanli 134 (1.72%), Plovdiv 187 (2.60%) and Dupnitsa 733 (2.67%).

Conclusion

Curing with yellowing stage shows reduction of nicotine content in comparison with reference values for all tested varieties except for the Plovdiv 7 variety. The most substantial drop in nicotine content is observed for Line 94 (-22.79 %) and the smallest – for the Dupnitsa 733 variety (-3.77 %). Only the Plovdiv 7 variety shows nicotine content increase by 8.16 %.

Curing with yellowing of all studied varieties of the Plovdiv and Macedonia tobacco regions increases sugar content. Highest increase of sugar content is found for tobacco of the varieties Kozarsko 339, Plovdiv 380 and Line 27 and the lowest – for Harmanli 132, Plovdiv 187 and Dupnitsa 733.

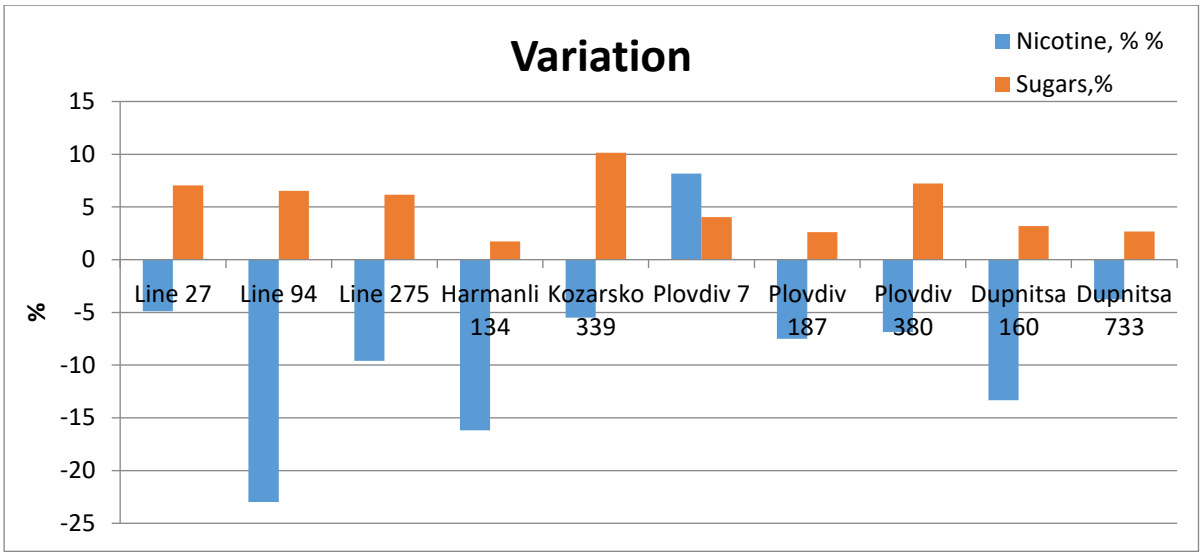

Figure 4. The percentage of variation nicotine and sugars in curing with yellowing stage of tobaccos

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