

# Studies on the Effects of Different Colored Cigarette Paper to Mainstream Smoke of Cigar

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Received: Nov. 1<sup>st</sup>, 2017; accepted: Nov. 13<sup>th</sup>, 2017; published: Nov. 20<sup>th</sup>, 2017

## Abstract

To reduce the contents of main negative direction ingredients (such as carbon monoxide, tar and nicotine) of mainstream smoke of machine-made miniature cigar, and promote the overall quality of cigar, studies on cigarettes with cut tobacco of different formulations rolled with selected colored cigarette paper have been conducted. After the analysis of chemical compositions of mainstream smoke and the sensory quality evaluation, the results showed that the 4 # cigarette paper is the best one to reduce the contents of carbon monoxide, tar and nicotine, and can effectively improve the sensory quality of cigar.

## Keywords

Machine-Made Miniature Cigar, Colored Cigarette Paper, Mainstream Smoke, Quality

# 不同有色卷烟纸对雪茄烟主流烟气影响的研究

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收稿日期: 2017年11月1日; 录用日期: 2017年11月13日; 发布日期: 2017年11月20日

## 摘要

为降低机制微型雪茄主流烟气主要负方向指标成分一氧化碳、焦油、烟碱含量, 提升烟支整体质量, 对

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文章引用: 刘路路, 张峻松, 周文, 宋世旭, 贾玉红, 胡希, 林勇, 杨振, 刘屹. 不同有色卷烟纸对雪茄烟主流烟气影响的研究[J]. 农业科学, 2017, 7(8): 562-565. DOI: [10.12677/hjas.2017.78074](https://doi.org/10.12677/hjas.2017.78074)

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### Abstract

To reduce the contents of main negative directive ingredients (such as carbon monoxide, tar and nicotine) of main stream smoke of machine made miniature cigars, and promote the overall quality of cigars, studies on cigars with cut tobacco of different formulas rolled with selected colored cigarette paper has been conducted. After the analysis of chemical compositions of main stream smoke and the sensor quality evaluation, the results showed that the 4 # municipal paper is the best one to reduce the content of carbon monoxide, tar and nicotine, and can effectively improve the sensor quality of city.

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### Summary

In order to reduce the content of carbon monoxide, tar and nicotine in the main negative direction indicators of the mainstream smoke of mechanical miniature cigars and improve the overall quality of cigarettes, a study was conducted on the selected colored cigarette paper rolled in different formulae of tobacco.

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Article citations: Lulu Liu, Junsong Zhang, Wen Zhou, Shixu Song, Yuhong Jia, Xi Hu, Yong Lin, Zhen Yang, Yi Liu A Study on the Effect of Different Colored Cigarette Papers on the Mainstream Smoke of Cigar Cigarettes [J] Agricultural science, 2017, 7 (8): 562-565 DOI: 10.12677/hjas.2017.78074

筛选的有色卷烟纸在不同配方烟丝中卷制烟支进行研究, 经过分析烟支主流烟气化学成分和感官质量评价, 结果表明: 4#卷烟纸降低烟支一氧化碳、焦油、烟碱量效果最好, 并且能有效改善烟支感官质量。

## 关键词

机制微型雪茄, 有色卷烟纸, 主流烟气, 质量

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## 1. 引言

目前机制微型雪茄烟普遍采用的是有色卷烟纸, 而有色卷烟纸卷制的雪茄烟主流烟气主要负方向指标成分一氧化碳量、焦油、烟碱偏高, 降低机制微型雪茄烟主流烟气负方向指标是保障机制微型雪茄烟安全性的重要手段。卷烟纸属于薄页纸, 作为卷烟辅助材料, 在烟草工业中占有较重要的地位。卷烟纸占机制微型雪茄烟烟支重量的 5% 左右, 由于它直接参与燃烧, 可通过控制烟支的燃烧性和对烟气的稀释作用来影响机制微型雪茄烟的燃烧性、香味和焦油、烟碱、一氧化碳产生量[1]。白色卷烟纸透气度、助燃剂含量对卷烟烟气常规指标的影响以往已有不少研究[1] [2] [3] [4], 通过提高卷烟纸的透气度和静燃速率可减少卷烟烟气中的负方向指标成分含量。然而, 关于有色卷烟纸对主流烟气负方向指标的影响研究报道较少, 机制微型雪茄烟大部分采用棕色卷烟纸卷制, 棕色卷烟纸卷制的雪茄烟烟气一氧化碳量偏高, 一般较白色卷烟纸卷制的雪茄烟高 5~6 mg。采用不同高透气度、不同工艺配方的有色卷烟纸在同一配方烟丝中进行应用对比, 探索能有效降低机制雪茄烟主流烟气主要负方向指标卷烟纸, 从而改善雪茄烟品质, 减少雪茄烟有害成分。

## 2. 材料与方法

### 2.1. 有色卷烟纸筛选

在供应商提供的卷烟纸中筛选出 2#、3#、4# 卷烟纸作为试验材料, 4 种卷烟纸相关技术指标见表 1, 其中 2# 卷烟纸和 3# 卷烟纸配方不同, 3# 卷烟纸钾离子含量高 1% 左右; 4# 卷烟纸在 3# 卷烟纸的基础上做调整, 钾离子含量增加, 颜色略作调整。采用机制微型雪茄在用的红棕色卷制纸作为对照(1# 卷烟纸)。

### 2.2. 有色卷烟纸卷制实验

以长城雪茄烟厂 2 款机制微型雪茄烟为研究载体, 分别编号为 Sptx、Spyw。

Sptx 配方烟丝分别采用 1# 红棕色卷烟纸、2#、3#、4# 有色卷烟纸, 同一普通醋酸纤维咀棒在同一台卷烟机上进行卷制, 并保证样品烟支的圆周、硬度及单支重量均在规定的允差范围内, 样品编号分别为 Sptx-1、Sptx-2、Sptx-3、Sptx-4 烟支规格为 84 mm (20 mm + 64 mm)。

Spyw 配方烟丝分别采用红棕色卷烟纸(对照卷烟纸)、2#、3#、4# 有色卷烟纸, 同一茶质复合咀棒在同一台卷烟机上进行卷制, 并保证样品烟支的圆周、硬度及单支重量均在规定的允差范围内, 样品编号分别为 Spyw-1、Spyw-2 和 Spyw-3、Spyw-4 烟支规格为 84 mm (30 mm + 54 mm)。

### 2.3. 样品检测和感官质量判定方法

#### 2.3.1. 主流烟气采用相应的国家和行业标准规定的方法测定烟气的焦油、烟碱、一氧化碳等

感官质量得分采用相应的国家和行业标准进行判定打分, 评价项目分别为颜色(份), 光泽(4 分),

After analyzing the chemical composition and sensory quality evaluation of the mainstream smoke, the results showed that: 4# cigarette paper has the best effect on reducing the amount of carbon monoxide, tar and nicotine in cigarettes, and can effectively improve the sensory quality of cigarettes.

### Keyword

Machine-made miniature cigars, colored cigarette paper, mainstream smoke, quality

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## 1. Introduction

At present, colored cigarette paper is commonly used in mechanical miniature cigars making, and the mainstream smoke of cigars made from colored cigarette paper has high negative indicators such as carbon monoxide, tar, and nicotine. Reducing the negative indicators of mainstream smoke in mechanical miniature cigars is an important method to ensure the safety of mechanical miniature cigars. Cigarette paper belongs to the category of thin sheet paper, which plays an important role in the tobacco industry as an auxiliary material for cigarettes. Cigarette paper accounts for about 5% of the weight of mechanical miniature cigar cigarettes. Due to its direct involvement in combustion, it can affect the combustibility, aroma, and tar, nicotine, and carbon monoxide production [1] of mechanical miniature cigar cigarettes by controlling the combustibility of the cigarettes and diluting the smoke. There have been many studies in the past on the influence of the air permeability and combustion promoter content of white cigarette paper on the conventional indicators of cigarette smoke [1] [2] [3] [4]. By improving the air permeability and static rate of cigarette paper, the negative direction indicator component content in cigarette smoke can be reduced. However, there are few reports on the impact of colored cigarette paper on the negative direction indicators of mainstream smoke. Most micro cigars are made of brown cigarette paper, and cigars made of brown cigarette paper have a relatively high carbon monoxide content in their smoke, which is generally 5-6 mg higher than those made of white cigarette paper. By comparing the application of colored cigarette paper with different high permeability and different process formulations in the same formula of cut tobacco, this study aims to explore the effective reduction of the main negative direction index of mainstream smoke in mechanical cigars, thereby improving the quality of cigars and reducing harmful components in cigars.

## 2. Materials and Methods

### 2.1. Colored cigarette paper screening

2 #, 3 #, and 4 # cigarette papers were selected as test materials from the cigarette paper provided by the supplier. The relevant technical indicators of the 4 types of cigarette papers are shown in Table 1. The formulas of 2 # cigarette paper and 3 # cigarette paper are different, and the

potassium ion content of 3 # cigarette paper is about 1% higher; 4 # cigarette paper is adjusted based on 3 # cigarette paper, with an increase in potassium ion content and slight color adjustments. The reddish-brown rolling paper used in machine-made miniature cigars was used as a control (1# cigarette paper).

## 2.2. Experiment on Making Colored Cigarette Paper

Using two types of mechanical miniature cigars from the Great Wall Cigar Factory as research carriers, numbered Sptx and Spyw respectively.

The Sptx formula cut tobacco is made of 1 # reddish brown cigarette paper, 2 #, 3 #, and 4 # colored cigarette paper, and the same ordinary acetate fiber tip is rolled on the same cigarette machine, ensuring that the circumference, hardness, and individual weight of the sample cigarettes are within the specified tolerance range. The sample numbers are Sptx-1, Sptx-2, Sptx-3, and Sptx-4, with cigarette specifications of 84 mm (20 mm+64 mm).

Spyw formula cut tobacco is made using reddish brown cigarette paper (control cigarette paper), 2 #, 3 #, and 4 # colored cigarette paper, and the same tea based composite nozzle rod is rolled on the same cigarette machine, ensuring that the circumference, hardness, and individual weight of the sample cigarettes are within the specified tolerance range. The sample numbers are Spyw-1, Spyw-2, Spyw-3, and Spyw-4, with specifications of 84 mm (30 mm+54 mm).

### 2.3.1. Sample Testing and Sensory Quality Assessment Methods

Mainstream flue gas is measured using the methods specified in corresponding national and industry standards to determine tar, nicotine, carbon monoxide, etc

The sensory quality score is determined and scored using corresponding national and industry standards. The evaluation items are color (6 points) and gloss (4 points), respectively,

**Table 1.** Technical index of colored cigarette paper**表 1.** 有色卷烟纸技术指标

样品编号	透气度(CU)	定量(g/m <sup>2</sup> )	宽度(mm)
1#卷烟纸(对照)	60	28	26.5
2#有色卷烟纸	60	28	26.5
3#有色卷烟纸	60	28	26.5
4#有色卷烟纸	60	28	26.5

香味(36分), 杂气(12分), 刺激性(14分), 余味(22分), 灰度(6分), 感官评价分值越高表明质量越好[5]。

### 3. 结果与分析

#### 3.1. 主流烟气常规化学成分分析

主流烟气常规化学成分分析中一氧化碳、烟碱、焦油是行业主要关注指标, 也是卷烟纸对产品质量影响的重要指标。由表2可以看出, Sptx-2、Sptx-3、Sptx-4与Sptx-1相比, 烟气烟碱量由高到低依次为Sptx-2、Sptx-3、Sptx-1、Sptx-4, 其中Sptx-4烟碱含量最低, 较Sptx-1低1.23%; 焦油含量由高到低依次为Sptx-2、Sptx-1、Sptx-3、Sptx-4, Sptx-4焦油含量最低, 较Sptx-1低4.71%; 烟气一氧化碳量由高到低依次为Sptx-2、Sptx-1、Sptx-3、Sptx-4, Sptx-4一氧化碳量最低, 较Sptx-1低12.76%。

Spyw-2、Spyw-3、Spyw-4与Spyw-1相比, 烟气烟碱量由高到低依次为Spyw-2、Spyw-3、Spyw-4、Spyw-1, 3种卷烟纸卷制烟支烟碱含量都较Spyw-1高, 其中烟碱含量最低的Spyw-4较Spyw-1稍高0.02mg; 焦油量由高到低依次为Spyw-1、Spyw-3、Spyw-2、Spyw-4, Spyw-4焦油量最低, 较Spyw-1低6.78%; 烟气一氧化碳量由高到低依次为Spyw-2、Spyw-1、Spyw-3、Spyw-4, Spyw-4一氧化碳量最低, 较Spyw-1低7.81%。

#### 3.2. 样品烟感官评吸结果

从表3中可以看出, 2种配方烟丝样品感官质量评价总分从高到低依次为Sptx-4、Sptx-1、Sptx-2、Sptx-3, Spyw-4、Spyw-1、Spyw-2、Spyw-3, 即4#卷烟纸在2种配方烟丝中综合感官质量评价分值都是最高, Sptx-4较Sptx-1高0.5分, Spyw-4较spyw-1高0.4分; 2#和3#卷烟纸综合感官质量得分都较对照得分低。Sptx-4风格特征明显, 香味醇正、协调性好, 优于Sptx-1、Sptx-2、Sptx-3; Sptx-3刺激性偏大, Sptx-2余味不干净、欠舒适。Spyw-4香气特征明显, 香气质感较好, 香气量足, 杂气较少, 协调性较好, 刺激性较小; Spyw-2和Spyw-3感官评价在香味、杂气和余味等指标上都欠佳。

### 4. 结论与讨论

(1) 4#有色卷烟纸在2种配方烟丝中降低烟气一氧化碳量、焦油量效果最好, 在Sptx配方烟丝中4#卷烟纸降低烟碱效果最好, 在Spyw配方烟丝中降低烟碱效果不明显。

2#卷烟纸在在Sptx配方烟丝中与对照相比不能降低一氧化碳、焦油、烟碱含量; 3#卷烟纸在Sptx配方烟丝中能有效降低焦油和一氧化碳含量, 不能降低烟碱含量。2#和3#卷烟纸在Spyw配方烟丝中与对照相比不能降低烟碱含量, 但都能有效降低焦油含量; 2#卷烟纸不能降低一氧化碳含量, 3#卷烟纸能有效降低一氧化碳含量。

(2) 4#卷烟纸在2种配方烟丝中综合感官质量评价分值都是最高, 说明4#卷烟纸在2种配方烟丝中均能有效改善烟支感官品质; 其它2种卷烟纸感官综合得分均低于对照得分, 也即2#和3#卷烟纸在2种配

**Table 1** Technical index of colored cigarette paper

**Table 1** Technical index of colored cigarette paper

Sample number	Breathability (CU)	Quantitative (g/m <sup>2</sup> )	Width (mm)
1 # cigarette paper (control)	60	28	26.5
2 # colored cigarette paper	60	28	26.5
3 # colored cigarette paper	60	28	26.5
4 # Colored Cigarette Paper	60	28	26.5

Fragrance (36 points), impurities (12 points), irritation (14 points), aftertaste (22 points), grayscale (6 points), higher sensory evaluation scores indicate better quality [5].

### 3. Results and Analysis

#### 3.1. Conventional chemical composition analysis of mainstream flue gas

Carbon monoxide, nicotine, and tar are the main indicators of concern in the mainstream chemical composition analysis of flue gas and are also important indicators of the impact of cigarette paper on product quality. From Table 2, it can be seen that compared with Sptx-1, Sptx-2, Sptx-3, and Sptx-4, the nicotine content of smoke was Sptx-2, Sptx-3, Sptx-1 and Sptx-4 in order from high to low, and the nicotine content of Sptx-4 was the lowest, 1.23% lower than that of Sptx-1; the tar content was Sptx-2, Sptx-1, Sptx-3 and Sptx-4 in order from high to low, and the tar content of Sptx-4 was the lowest, 4.71% lower than that of Sptx-1; the carbon monoxide content of flue gas is Sptx-2, Sptx-1, Sptx-3 and Sptx-4 in order from high to low, and the carbon monoxide content of Sptx-4 is the lowest, which is 12.76% lower than that of Sptx-1.

Comparing Spyw-2, Spyw-3, Spyw-4 with Spyw-1, the smoke nicotine content is Spyw-2, Spyw-3, Spyw-4, Spyw-1 in order from high to low. The nicotine content of the three kinds of cigarette paper is higher than that of Spyw-1. Spyw-4, the lowest among the three, is 0.02 mg higher than Spyw-1. The coke content from high to low is Spyw-1, Spyw-3, Spyw-2, Spyw-4, with Spyw-4 having the lowest coke content, 6.78% lower than Spyw-1. The carbon monoxide content of the flue gas is Spyw-2, Spyw-1, Spyw-3 and Spyw-4 in order from high to low, and the carbon monoxide content of Spyw-4 is the lowest, 7.81% lower than that of Spyw-1.

#### 3.2. Results of sensory evaluation of sample smoke

As can be seen from Table 3, the total score of sensory quality evaluation of the two formulated tobacco samples was Sptx-4, Sptx-1, Sptx-2, Sptx-3, Spyw-4, Spyw-1, Spyw-2, Spyw-3, in order from high to low. That is, the comprehensive sensory quality evaluation score of the 4# cigarette paper is the highest among the two formulations. The Sptx-4 is 0.5 points higher than the Sptx-1, and the Spyw-4 is 0.4 points higher than the spyw-1. Both the 2# and 3# cigarette paper

had lower sensory quality scores than the control paper.

Sptx-4 is superior to Sptx-1, Sptx-2 and Sptx-3 because of its distinctive style, mellow aroma and good harmony. Sptx-3 irritant is too large, while Sptx-2 aftertaste is not clean and not comfortable.

Spyw-4 has obvious aroma characteristics, with better aroma texture, sufficient aroma, less impurity, better harmony and less irritation. The Spyw-2 and Spyw-3 sensory evaluations were poor in terms of aroma, fumes and aftertaste.

#### 4. Conclusion and Discussion

(1) The 4# colored cigarette paper has the best effect on reducing the amount of carbon monoxide and tar in the flue gas among the two formulations. The 4# cigarette paper has the best effect on reducing nicotine in Sptx formula tobacco, and its effect on reducing nicotine in Spyw formula tobacco is not obvious.

2 # cigarette paper cannot reduce the content of carbon monoxide, tar, and nicotine in Sptx formula cut tobacco compared to the control. 3# cigarette paper in Sptx formula tobacco can effectively reduce tar and carbon monoxide content but cannot reduce nicotine content. The 2# and 3# cigarette paper did not reduce the nicotine content in the Spyw formula compared to the control, but both effectively reduced the tar content.

2# cigarette paper cannot reduce the carbon monoxide content, while 3# cigarette paper can effectively reduce the carbon monoxide content.

(2) The comprehensive sensory quality evaluation scores of 4# cigarette paper were the highest among the two formulations, indicating that 4# cigarette paper could effectively improve the sensory quality of cigarettes in both formulations. The sensory comprehensive scores of the other 2 kinds of cigarette paper were lower than the control scores, that is, the 2# and 3# cigarette paper could not improve the sensory quality of cigarettes in the 2 kinds of formula tobacco.

**Table 2.** Themainstreamsmokeofdifferent sample of colored cigarette paper**表 2.** 不同卷烟纸样品主流烟气检测表

样品名称	Sptx-1	Sptx-2	Sptx-3	Sptx-4	Spyw-1	Spyw-2	Spyw-3	Spyw-4
烟蒂长度(mm)	33	31	33	32	38	38	38	38
总粒相物(T.P.M) (mg/支)	11.60	12.29	11.78	11.62	10.01	10.37	9.77	9.68
水分(mg/支)	1.75	1.87	1.83	1.68	1.21	1.13	0.95	1.27
烟碱(mg/支)	0.81	0.86	0.85	0.80	0.75	0.85	0.79	0.77
焦油(mg/支)	11.04	11.56	10.95	10.52	8.85	8.39	8.43	8.25
一氧化碳(mg/支)	13.40	14.19	13.24	11.69	12.67	12.93	12.28	11.68
平均口数(口/支)	6.13	7.12	6.78	6.50	5.85	6.48	6.31	5.79

**Table 3.** Thesensoryevaluationformofdifferentsample of colored cigarette paper**表 3.** 不同卷烟纸样品感官质量评价表

项目 sptx-1	颜色	光泽	香味	杂气	刺激性	余味	灰度	合计
sptx-2	5	3	30	10	12	19	5	84
sptx-3	5	3	29.5	9.4	11.8	18.8	5	82.5
sptx-4	5	3	29.6	9.3	11.5	18.7	5	81.8
spyw-1	4.5	3.0	30.1	10.2	12.0	19.7	5	84.5
spyw-2	5	3.5	31.5	10.7	12.3	20	5	88
spyw-3	5	3.5	31.2	10.3	12.1	19.8	5	86.9
spyw-4	5	3.5	31.1	10.2	11.5	19.6	5	85.9
	5	3.5	31.8	10.6	12.3	20.2	5	88.4

方烟丝中不能改善烟支感官质量。

(3) 筛选的 3 种卷烟纸在 2 种配方烟丝中进行的研究结果表明, 4#卷烟纸降低烟支一氧化碳、焦油、烟碱量效果最好, 并且能有效改善烟支感官质量。本研究为有色卷烟纸的进一步研究及改进, 提供了基础数据参考, 在新产品设计过程中辅助材料的搭配提供了理论依据, 也为减害降焦提供了数据参考。

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**Table 2** The mainstream smoke of different sample of colored cigarette paper

**Table 2** The mainstream smoke of different sample of colored cigarette paper

Sample Name	Sptx-1	Sptx-2	Sptx-3	Sptx-4	Spyw-1	Spyw-2	Spyw-3	Spyw-4
Cigarette butt length (mm)	33	31	33	32	38	38	38	38
Total particulate matter (T.P.M) (mg/tube)	11.60	12.29	11.78	11.62	10.01	10.37	9.77	9.68
Moisture (mg/piece)	1.75	1.87	1.83	1.68	1.21	1.13	0.95	1.27
Nicotine (mg/dose)	0.81	0.86	0.85	0.80	0.75	0.85	0.79	0.77
Tar (mg/piece)	11.04	11.56	10.95	10.52	8.85	8.39	8.43	8.25
Carbon monoxide (mg/piece)	13.40	14.19	13.24	11.69	12.67	12.93	12.28	11.68
Average number of mouths (mouth/piece)	6.13	7.12	6.78	6.50	5.85	6.48	6.31	5.79

**Table 3** The sensory evaluation form of different sample of colored cigarette paper

**Table 3** The sensory evaluation form of different sample of colored cigarette paper

Item	colour	gloss	aroma	Miscellaneous gas	Irritability	Aftertaste	Gray scale	total
Sptx-1	5	3	30	10	12	19	5	84
Sptx-2	5	3	29.5	9.4	11.8	18.8	5	82.5
Sptx-3	5	3	29.6	9.3	11.5	18.7	5	81.8
Sptx-4	4.5	3.0	30.1	10.2	12.0	19.7	5	84.5
Spyw-1	5	3.5	31.5	10.7	12.3	20	5	88
Spyw-2	5	3.5	31.2	10.3	12.1	19.8	5	86.9
Spyw-3	5	3.5	31.1	10.2	11.5	19.6	5	85.9
Spyw-4	5	3.5	31.8	10.6	12.3	20.2	5	88.4

(3) The results of the study of the three kinds of cigarette paper screened in the two kinds of formula tobacco showed that the 4# cigarette paper had the best effect on reducing the amount of carbon monoxide, tar and nicotine, and could effectively improve the sensory quality of cigarettes. This study provides basic data reference for the further research and improvement of colored cigarette paper, provides theoretical basis for the collocation of auxiliary materials in the process of new product design, and also provides data reference for damage reduction and coke reduction.

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