

PAPER SURFACE APPLICATION WITH NATURAL HERBAL EXTRACTS FOR PRINTING INKS

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Abstract

It is certain that printing with natural dye materials will be suitable for use in special areas such as baby products, kindergarten children's activity books, food packaging paper, paper cups, cigarette paper, etc. The production and commercialization of natural dyes and pigments gains importance reasonable quantities in this respect.

It is measured in this study that how the natural extracts give different colors on different paper types. In order to prepare the ink, cyan, yellow, black, magenta colors have been tried to be prepared so as to have the color characteristics closest to the printing inks in marketing products. The color differences between coated with ink that used in the market and coated with natural herbal extracts papers were evaluated. The color values by the CIE L * a * b * color space system of natural print ink are determined. An analytical method was developed for the analysis and printing of the natural printing properties of the ink obtained from the herbal source.

Key words: *Natural printing ink*

Introduction

The use of pigments from the roots, stalks, leaves, flowers and fruit of plants is as old as humanity. However, after the synthetic dyes were discovered in the early 20th century, the use of plants began to diminish and faced with the danger of partial or total extinction and this materials could not afford a large-scale industrial production.

Consequently, pigments and dyes are produced by chemical compounds have widely demanded until today (Gilbert & Cooke, 2001). Natural dyes and pigments was once more important when it was discovered in the 1980s that a large percentage of synthetic versions were toxic, carcinogenic or polluted. On the other hand, due to environmental regulations limiting various substances in printing and pulp and paper industry, research for natural organic printing ink and dyes gains popularity especially food contact papers

(Forrest, 2005). It is certain that printing with natural dye materials will be suitable for use in special areas such as food contact paper packages, baby products, cigarette paper. There are many special requirements for producing these products and there is an expectation that the production of these products will increase in the future (Shahid, Shahid-ul-Islam, & Faqeer, 2013). Natural organic printing ink does not pollute the environment. They are neither toxic nor carcinogenic. This means that all components created from natural ingredients. Natural printing inks have advantages because their productions express renewable resources that cause minimal environmental pollution and have a low risk factor associated volatile organic compounds in solvents (Porter & Linde, 2000). Even more applications for edible inks are being developed (US Patent No. US 7,842,320 B2, 2010). Nevertheless, they need to be improved due to their natural character is prone to give low pH and heat stability, low light fastness value and they are easily degradable. However, this is not the biggest obstacle to their production. Extracts from natural dyes may contain different features due to their growing climate, condition, place. It is a low possibility to get extracts with the same characteristics from natural dyes. Besides all these negative effects, when they are applied to the paper surface they can also react with paper additives such as fillers, sizing agents, binders or even with cellulose.

This work could lead to the development of non toxic, biodegradable, environmentally friendly digital printing inks. As main printing colors, cyan, magenta, yellow and black tried to be prepared. Turmeric extract (*curcuma longa*) for yellow color, hibiscus extract (*Hibiscus sabdariffa*) and rosehip extract (*Rosa canina*) for red, and indigofera tinctoria L. for blue were applied to different paper surfaces.

Because of each color application gives different CIE lab. results revealed the necessity of developing natural inks for paper properties. In the next step, it can be considered that these results will be completed by measuring the ink stability in 3 months period.

Experimental Material and Method

Main colors were tried to be obtained by natural substances with hot water extraction. Extraction was carried out at 65 °C for 8h in a hot water bath. Distilled water used in all processes. 0,5% (w/w) arabic gum mordant and 0.5% (w/w) NaCl (Merc) were added to the samples when samples cooled to 30°C. Buffer solution was not added since pH sensitivity of the natural colorants. The plant samples were taken from the local market (Grand Bazaar) in closed packages.

Extracted ink (E) samples obtained from plant sources. Turmeric extract (*curcuma longa*) for yellow color, hibiscus extrema (*Hibiscus sabdariffa*) and rosehip extract (*Rosa canina*) for red, and indigofera tinctoria L. for blue, *Alkanna tinctora* extract for black, tried to be obtain. Cyan (C), magenta (M), yellow (Y) and black (K) colors were tried to be reached from the main colors in printing inks. Canon 3230 model printer inks (I) were applied to the paper for comparison.

Three types of base paper were used for coating application. These were hand made paper from virgine cellulose (H), one side PE coated cardboard for paper cups (P) and office paper (O) with calcium carbonate surface treatment.

After the printing inks were prepared, they were coated with various papers. The same papers were also coated with the supplied printing ink and CIE lab. color measurements were evaluated with the Elrepho (Code 70, Type 991286, No 8803564).

All the paper surface were coated single side with coating applicator (Film coater model K202 from RK print coat instrument) using # 0 bar. The applicator speed was 3 cm/s. Basis weights of the paper samples were given in Table 1.

Coated samples were conditioned prior and after coating application at 23°C and 50% relative humidity for 24 hours according to ISO 287. Color measure performed under 10 ° observer and a D65 light source in İstanbul University, Faculty of Forestry, Department of The Chemistry and Technology of Forestry Products SEKKA Laboratory. CIE L * a * b * results of all samples given in Table 3. In addition, ΔE, ΔL, Δa and Δb values were calculated according to ISO 12647-2. Color results of coated paper were also given in Table 1 and 2.

Table 1. Grammage and Color Results from Paper Samples

Color code	Grammage	L	a	b	Chroma	ΔE
H	82.64	88.40	2.80	9.92	-	-
O	117.24	94.73	1.52	-3.56	-	-
P	180.42	96.25	-0.82	7.26	-	-
EYH	101.98	85.23	0.74	43.80	43.81	51.54
EYO	123.22	93.33	-2.58	15.53	15.74	26.52
EYP	196.34	95.64	-3.53	19.99	20.30	29.92

Color code	Grammage	L	a	b	Chroma	ΔE
EMH	100.60	71.65	17.24	3.96	17.69	38.69
EMO	126.43	81.20	3.18	-2.29	3.92	53.82
EMP	187.77	87.19	9.66	5.55	11.14	58.75
ECH	85.49	59.97	-6.37	-7.30	9.69	33.30
ECO	123.81	83.72	-3.32	-8.57	9.19	48.63
ECP	195.20	88.17	-5.50	1.28	5.65	52.99
EKH	94.34	69.10	2.78	12.49	12.80	44.61
EKO	127.59	79.30	1.77	16.17	16.27	49.46
EKP	192.51	82.02	1.05	17.51	17.54	50.38

Table 2. Grammage and Color Results from Paper Samples

Color code	Grammage	L	a	b	Chroma
IYH	104.17	72.83	24.91	0.00	24.91
IYO	124.93	80.59	14.74	0.00	14.74
IYP	182.54	83.14	14.89	0.00	14.89
IMH	83.14	38.38	32.76	-8.24	33.78
IMO	128.52	47.25	42.47	-16.44	45.54
IMP	199.57	44.77	45.14	-14.28	47.34
ICH	90.51	42.33	-23.72	-29.58	37.92
ICO	130.43	48.22	-26.01	-32.85	41.90
ICP	194.38	53.54	-30.65	-29.97	42.87
IBH	94.28	26.05	0.38	1.03	1.10
IBO	123.30	32.16	0.89	1.23	1.52
IBP	199.41	33.32	1.07	4.59	4.71

Conclusions

The formulation improved of appropriate printing inks and the potential use of four main color of natural dyes were examined for the analysis of the color properties of the inks obtained from natural pigments. It was evaluated how close the original ink CIE Lab values compared to prepared ink from natural substances. It was estimated that magenta color values can be improved with various additives. Natural inks will be used more in special areas such as the printing of paper cups, food packaging, babys products through biodegradable, environmental friendly features. It was observed that the colors of some of this natural inks reacted with some paper surface materials. However, the results were promising, and this opens up the production of environmentally friendly inkjet ink for use digital printing. It is predicted that using natural printing inks will provide a cleaner system during the ink removal in terms of paper recycling process. The effect of the natural printing ink on the recycling of the paper may be the subject of another study.

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