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Synthetic food colorants in soft drinks from the Romanian market

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Introduction

Water soluble synthetic food colorants are widely used in the production of beverages for improving their appearance, being highly appreciated by producers especially due to their stability, compatibility with the food matrix, tinctorial power and price [4, 5].

However, previous studies on the toxicity of these food additives highlighted several worrying health-related issues on consumers: an excessive consumption of certain synthetic food colorants can cause allergic reactions, attention deficit hyperactivity disorder (ADHD) in sensitive children, or even cancer. Because soft drinks are highly-consumed beverages amongst all age groups, especially teenagers and children, they can be considered as a health risk for consumers [1, 2, 3, 7]. Hence, the use of synthetic colorants in foods is regulated by legislation and harmonized across the European Union [8, 9, 10]. Thus, accurate and reliable methods for the determination of these compounds are required for a proper food safety.

Synthetic food colorants can be analyzed using visible spectrophotometry, thin layer chromatography, high performance liquid chromatography (HPLC), ion chromatography and capillary electrophoresis [6]. From these, HPLC is by far the most versatile and advantageous, hence this was the method of choice in the present work.

Research objectives

The aims of the present work were:

- to develop a reversed-phase high performance liquid chromatographic method for the determination of the commonly used synthetic food colorants in a minimum separation time and to use it
- to provide data on the content of these food additives from several soft drinks available on the Romanian market

The targeted synthetic food colorants in this study were: Allura Red (E 129), Azorubine (E 122), Brilliant Blue FCF (E 133), Patent Blue (E 131), Ponceau 4R (E 124), Ponceau 6R (E 126), Tartrazine (E 102) and Sunset Yellow FCF (E 110).

Material and methods

83 soft drinks were purchased from hypermarkets; reference food colorants used for calibrations were from Merck, as well as the solvents (HPLC grade).

Sample preparation: carbonated soft drinks were degassed on an ultrasonic bath before extraction (5 minutes at room temperature), afterwards subjected to solid phase extraction on Sep-Pack C_{18} cartridges, then filtered through 0.45 µm membrane filters.

Analytical determinations were performed by high performance liquid chromatography (HPLC) on an Agilent 1100 system equipped with an diode array detector (DAD), separations being accomplished on a C_{18} column, using gradient elution with ammonium acetate buffer and acetonitrile as the mobile phase. The diode-array detector was programmed to monitor the analytes at Λ_{max} in the range of 350–800 nm. Quantification was based on the external standard method.

The HPLC method was optimized and validated, using wavelengths programming in the visible range to provide the highest sensitivity and specificity.

Results

HPLC analysis revealed different chromatographic profiles of synthetic colorants in the analyzed soft drinks, containing one (fig.1), two (fig.2) or more colorants.

Figure 1. Representative HPLC chromatogram for a soft drink containing only one colorant (Brilliant Blue)

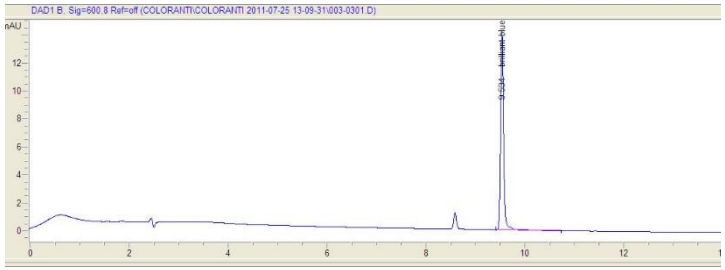
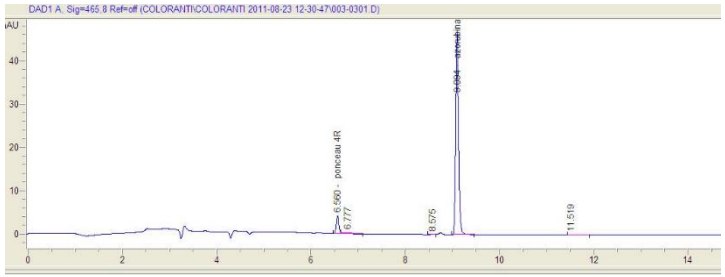
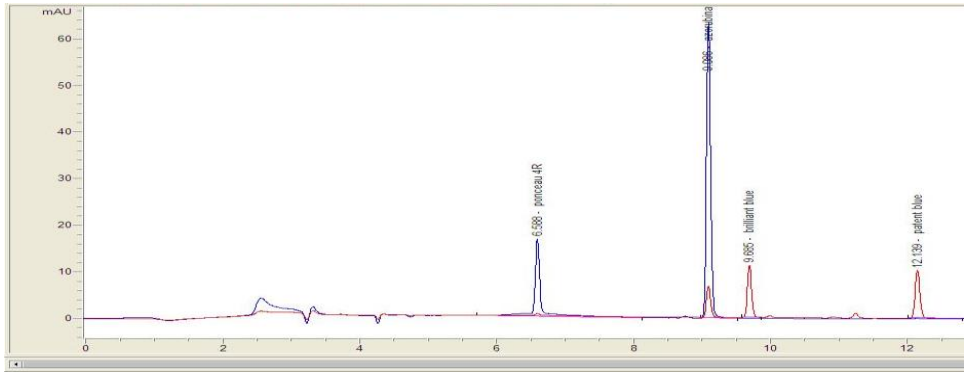


Figure 2. Representative HPLC chromatogram for a soft drink containing two colorants ((Ponceau 4R and Azorubin)



Results

Figure 3. Representative HPLC chromatogram for a soft drink containing four colorants (Ponceau 4R, Azorubin, Brilliant Blue, Patent Blue)



The quantitative results obtained are summarized in Tables 1 and, revealing both the range of concentrations and the types of colorants.

Results

Table 1. Concentration ranges for synthetic colorants in soft drinks [mg/ L]

Analyte	Min value	Max value	Nr. of samples	Maximum levels - EU [8]	Maximum levels - RO [10]
Allura Red	Not detected	Not detected	-	100	100
Azorubine	0.72	56.84	38	100	50
Brilliant Blue FCF	0.88	7.15	29	100	100
Patent Blue	0.63	6.80	21	100	100
Ponceau 4R	0.15	31.49	10	100	50
Sunset Yellow FCF	1.78	42.45	43	100	100
Tartrazine	1.01	30.51	25	100	50

Results

Table 2. Situation of samples found to contain undeclared synthetic food colorants

Analyte	Nr. of samples
Azorubin	9
Brilliant Blue	8
Patent Blue	4
Ponceau 4R	3
Sunset yellow	1
Tartrazine	3

Conclusions

The developed HPLC-DAD method proved to be fast (less than 15 minutes run-time), sensitive, accurate and suitable for the routine analysis of soft drinks containing a broad range of colorants.

The obtained results showed that:

- in certain products, besides the declared colorants of the label, several undeclared ones were present;
- food colorants were generally added in low and rather safe amounts, all samples revealing colorants' levels in conformity with Romanian and EU regulations;
- less than 30% of the analyzed soft drinks have in the composition a single synthetic food colorant, most of them containing two (~50%), three 3 (~15%) or even four 4 colorants (~5%).

The proposed method is recommended for quality control of the synthetic colors in soft drinks, as well as to determine whether the concentrations of these compounds comply with the requirements of the current legislation.

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Many thanks for your attention!

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