Azo Dye Metabolite Standards

Author: John Barron, Technical Director, Reagecon Diagnostics Ltd, Shannon Free Zone, Shannon, County Clare, Ireland.

Abstract

Azo-dyes are synthetic organic dyes, that contain nitrogen in the form of an azo group in their structure. Such dyes have a host of attributes that render them preferable as food additives, in comparison to natural dyes. However, they also lead to significant adverse health effects due to the formation of aromatic amines. Therefore, they have been the subject of widespread legislative control and attention from various regulatory panels and expert bodies. There is a widespread and growing requirement to measure the metabolites of azo dyes to a high degree of sensitivity, generally using chromatographic methodologies. Reagecon offers several ready to use azo dye metabolite standards dissolved in a number of matrices, to facilitate these testing requirements.

Introduction

Azo-dyes are a large class of synthetic organic dyes that contain nitrogen in the form of an azo group (-N=N-), as part of their molecular structures. They are used in many areas such as the food, cosmetic, textile[(1)], leather, nutrition, plastic and pharmaceutical industries. During the past 50 years, the amount of azo-dyes used in foods has increased by 500%. When compared to natural dyes, synthetic food dyes provide many advantages. Synthetic dyes are cheaper, more easily available, last longer and can achieve colour and hue variations otherwise not possible using natural colourants. They also provide superior colour fastness and colour intensity.

However, since the use of synthetic food colouring has become widespread, many allergic and other immune reaction disorders, have increasingly been reported. The reductive cleavage of the azo bond leads to the formation of aromatic amines which may be mutagenic, carcinogenic or allergenic. For instance, acid red 85 and direct blue 6, are both capable of reductively splitting to produce carcinogenic benzidine. Likewise, Sudan II and disperse yellow 7 are capable of splitting to form p-phenylenediamine and aniline, while disperse orange 3 can split only to p-phenylenediamine. [(1)]

Legislation

Colour Directive 94/36/EC outlines the permitted natural and synthetic colours with their approved applications and limits in different foodstuffs (Commission, 1994) and the use of azo-dyes which can be reduced into toxic amines is prohibited in Europe, US and many other countries. The safety of food colours and other food additives in the EU is evaluated by the European Food Safety Authority (EFSA). Since 2009, the expert Scientific Panel of EFSA assess all of the permitted food colours (45 in total) which had been approved for use in the EU giving priority to those synthetically produced and then to those obtained from natural sources mainly carotenoids. Since new scientific data became available, there have been changes in the legislation, many additives which were initially authorised for use in the past, are currently not permitted in food products in the EU. Unfortunately, there are reports of food adulteration, using dyes unauthorised for food which are often hazardous.

Illegal Adulteration

There have been many notifications from several EU Member States via the Rapid Alert System for Food and Feed (RASFF) of the occurrence of Sudan I, II, III and IV, para red, rhodamine b, and orange

2 in chilli and curry powder and processed products containing chilli or curry powder, sumac, curcuma and palm oil among others. There have also been occurrences of azo dyes released from clothing and textiles, which may be accidently ingested intradermically or orally by people wearing such clothes. Textile workers are also at risk.

Metabolite Standards

Efficient analytical methods for the determination of food colorants are of utmost importance since their illegal presence in food threatens consumer's safety. Up to now, most methods are focused to detect dyes so far found illegally present in food. There are no methods focused in the detection of aromatic amines derived from azo dyes which may potentially appear illegally in food and show carcinogenic effects in humans.

In a study funded by and participated in by scientists in Reagecon, we have taken account of this consideration and have tried to fill this void. For example, we have provided and published a rapid, accurate and precise method for the identification and quantification of various synthetic food colourant products in paprika.[(2)] As always, our principle role has been to characterise, purify, validate and offer high quality standards for these products and disseminate these into the marketplace. Further details can be found at www.reagecon.com

References

[(1)] Report 6/14 Chemicals in textiles - risks to human health and the environment. 2014. KEM Swedish Chemicals Agency, Stockholm

[(2)] Otero, P., Barron, J., Kumar Saha, S., Hussein, A., Murray, P., 2016. Simultaneous Determination of 23 Azo Dyes in Paprika by Gas Chromatography-Mass Spectrometry