Elution of Artificial Colors from Cardboard and Wrapping Paper Used for Food Packages

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ABSTRACT

In Japan artificial colors and pigments can be used for food packages if they are processed so that the artificial color or pigment will not be eluted to contaminate food. Ten samples of cardboard and five samples of wrapping paper were subjected to the elution test. One hundred cm² of cardboard or paper was immersed in water at 40°C and held for 30 min. Artificial color was eluted from all samples of whole cardboard and, when it was divided into three parts (surface, inner part and reverse side) to do the elution test separately, artificial color was eluted from all parts except with one sample when color was eluted only from inner part. By comparing Rf values on a paper chromatogram as well as its maximal absorbance with color standards, the eluted color was identified to be croceine orange. Congo red and croceine orange were eluted each from one sample of wrapping paper.

In Japan, the Notification regarding Standards and Specifications of Food, Food Additives etc. (Ministry of Health and Welfare Notification No. 370, December 28, 1959) prescribes that apparatus and package shall not contain artificial colors except those listed in Table 2 of the Enforcement Regulation of the Food Sanitation Law (Ministerial Ordinance No. 23, July 13, 1948). It is permitted, however, to use artificial colors and pigments not listed in Table 2, if the apparatus or package is processed so that the artificial color or pigment will not be eluted to contaminate food. The elution test is prescribed in Notification No. 370 and the test of plastic apparatus and packaging material should be carried out by use of water at 60°C for 30 min. In the same notification it is prescribed that the test for origami (colored paper for folding play by babies) should be carried out by use of water at 40°C for 30 min. As yet, no elution procedure is prescribed for the test of cardboard and wrapping paper.

In the Sanitary Inspection Guide (1), however, it is tentatively indicated that solution for checking elution from paper and converted paper is to be prepared by use of either water, 4% acetic acid or 0.1% ammonia-water. Examples for eluting conditions are as following: (a) leave for a definite period (10 min, 24 h) at room temperature, (b) use eluting solution at 40°C and leave for 30 min at 40°C, (c) use eluting solution at 60°C and leave for 30 min at 60°C, (d) use eluting solution of 80 ± 2°C and leave for 30 min at room temperature, or (e) use boiling elution solution and boil for 30 min.

Conditions (a) and (b) are recommended for the elution test of paper products in general, (c) is to be applied for the elution test of laminated paper products (for instance, paper drinking glass and paper dish), (d) is applicable to test paper containers for hot coffee and other hot products, while (e) is to be applied to test tea-bags and paper pans.

Japan imports quantities of dried fish every year from abroad as raw material for preparation of “Tsukudani” (preserved food boiled down in soy sauce). The fish are usually imported directly packed in cardboard with bottom and sides being covered with thin wrapping paper. By request of government food sanitation inspectors residing at the Moji port, we had many chances to inspect such paper products during the first half of 1978.

MATERIALS AND METHODS

Paper samples

Ten kinds of cardboard and five kinds of wrapping paper were used as test samples. Cardboard was divided into three parts (surface, inner part and reverse side), and the elution test was done on whole cardboard and the three parts.

Preparation of test solution for dye elution and identification

One hundred cm² of paper sample was dipped into 200 ml of water of 40°C and was held 30 min at 40°C. Elution of dye from paper was judged by taking 50 ml of the test solution into a Nessler's tube of 50 ml (specifications: internal diameter, 20 mm; the distance from the base to the bottom face of glass stopper, 20 cm) and by observing the color from the top and side against a white background. When the test solution was judged to be colored, the extract solution was concentrated to 5 ml in vacuo and the eluted artificial color in the concentrate was extracted and purified by the wool dyeing method (2). Dyes were eluted from wool with dilute ammonia water and the preparations were separated by paper chromatography. Toyo filter paper No.50, 2 x 40 cm, was used with two developing systems of 25% ethanol:1% ammonia-water (6:2:3). The developed color was identified by comparing its Rf value with color standards as well as by measuring its maximal absorbance.

RESULTS AND DISCUSSION

From data in Table 1 it is clear that all the test solutions of whole cardboards were judged to be colored. Results of separate inspection confirmed that colors were eluted from the surface, inner part and reverse side except for sample No. 2 where color was eluted from only the inner part.

On the paper chromatogram, the eluted color had a Rf value of 0.45 with the first developer and 0.68 with the second developer, respectively. The maximal absorbance
TABLE 1. Elution test on cardboard.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Surface</th>
<th>Inner part</th>
<th>Reverse side</th>
<th>Whole</th>
<th>Identification of eluted color</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>+(a)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Croceine orange</td>
</tr>
<tr>
<td>No. 2</td>
<td>–(b)</td>
<td>+</td>
<td>–</td>
<td>+</td>
<td>Croceine orange</td>
</tr>
<tr>
<td>No. 3</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Croceine orange</td>
</tr>
<tr>
<td>No. 4</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Croceine orange</td>
</tr>
<tr>
<td>No. 5</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Croceine orange</td>
</tr>
<tr>
<td>No. 6</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Croceine orange</td>
</tr>
<tr>
<td>No. 7</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Croceine orange</td>
</tr>
<tr>
<td>No. 8</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Croceine orange</td>
</tr>
<tr>
<td>No. 9</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Croceine orange</td>
</tr>
<tr>
<td>No. 10</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Croceine orange</td>
</tr>
</tbody>
</table>

\(a\) + : Color was eluted.
\(b\) – : Color was not eluted.

Detection limit: One \(\mu g\) of Croceine orange in one \(cm^2\) of cardboard.

of the colored solution and extracted dye were known to be around a wavelength of 483 nm, being quite coincident with \(R_f\) values and maximal absorbance of croceine orange (Fig. 1).

croceine orange (CI Acid orange 12), \(C_{16}H_{13}N_2O_4S\cdotNa\).

Croceine orange (CI Acid Orange 12, CI 15970) is a kind of acid dye that is not designated as a food additive in Japan. Nine cardboards, except No. 2, were disqualified because of elution of croceine orange. Since the dye was eluted only from the inner part in sample No. 2, it may not migrate into foods. It must be noted that, besides croceine orange, unknown natural colored constituents which might have been derived from pulpwod were detected in each test solution. Such substances would not develop on paper chromatogram and remained at the starting point. As for wrapping paper, samples No. 1 and 2 were rejected because congo red (direct cotton dye) and croceine orange were detected from the test solution of No. 1 and 2, respectively.

In the 5th paragraph of Article 2 in Food Sanitation Law it is defined that "container-package" means the articles in which foods or additives are contained or packaged and are to be offered therein when the foods or additives are delivered. Accordingly, it will be unnecessary to carry out the elution test on cardboard and wrapping paper if foods are packed in them after having been wrapped in polyethylene or polyvinyl chloride films, for example.

REFERENCES