Title | Colour and its measurement in Foods
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and storage practices will also result in the minimum of drip losses on thawing. Phosphates then will reduce weight loss on thawing, particularly from poorly frozen and stored fish. They will not effect the storage life of fish products, however, they may improve the appearance, particularly with poor quality raw material, dipping may mask some of the physical deterioration and thus give the impression of improved quality.

In fatty fish antioxidants have been shown to be more effective in the presence of phosphates. Some of the phosphates used commercially for fish include: sodium tripolyphosphate, sodium and potassium pyrophosphate. A 10% solution is normally recommended for dipping purposes. Higher levels may be used, however, an alkaline flavour which detracts from product quality can be imparted.

Colour and its measurement in foods

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The three main aspects of food sensory quality are appearance, sense of feel or texture and flavour. Of the three, appearance characteristics are probably the most important and the saying ‘We eat with our eyes’ is very true in most cases. Appearance factors can be subdivided into a number of areas: colour, gloss, shape, size, defects, oiliness, viscosity, etc.

Colour is very important in food and is used to judge the quality, maturity and age after harvest of many foods. Leafy vegetables are expected to be a fresh green colour, carrots should be a deep orange, strawberries and meat a bright red, tomatoes yellow-red to red and pastries a nice golden brown. Consumers often demand colours in foods that are not natural to the foods themselves and consumers in different countries have different colour preferences.

What is colour?

The human eye is sensitive to radiation in the wavelength region 380 to 760 mµ which produces the colour spectrum as we know it. In practical terms, colour may be thought of as having three attributes which can be expressed in a three-dimensional colour solid:

1. Dominant wavelength or hue
2. Lightness or value of reflectance
3. Purity or chroma or intensity

Dominant wavelength refers to the actual colour of the object. If the reflected wavelength is 650-700 mµ the object will look red. Lightness is a measure of the whiteness or darkness of an object on a scale from white through grey to black. Lastly, purity refers to the intensity of the colour. The narrower the wavelength span for a colour the more intense it will be.

Objective versus subjective measurement

Objective methods for measuring colour are more precise than subjective methods and can usually be converted to x, y and z values of the CIE standard system. This is the system recommended by the International Committee on Illumination and is based on the ‘standard observer’ which may be thought of as a simulated standard eye.

Colour of a set of samples can be assessed quite well with a visual panel. However, human colour memory is bad and this type of subjective assessment fails when the panel is asked to compare the colour of the samples with those they saw some weeks previously. An objective method is usually necessary for any colour measurement which is being carried on over a period of time.

Visual panels are very important when calibrating an objective method. It is important to relate the spread of values obtained from an objective method with the visual spread from a panel, eg, if the panel considers that there is a large colour difference between two samples it is important that this also shows up as a large difference in readings on the instrument.

Colour charts can be very useful provided their limitations are realized. Use of a colour chart book is not recommended; colour charts should be made for a particular purpose when required. If for example, carrot colour is being measured, three or four charts covering the relevant colour range can be made. They should be calibrated with an objective instrument such as a Hunter Colour Difference meter. This enables them to be checked for fading and also increases the objectivity of the chart test. The fact that the colour of the object must be matched visually to the chart may also introduce error.

Objective tests and colour

A number of methods are available for measuring food colour objectively. Pigment may be extracted from the sample with a solvent and the absorbance of the solution, measured at a selected wavelength on a spectrophotometer. Colour can also be measured by matching (with the eye) a liquid system containing the desired constituent in unknown amount with a similar system containing the desired constituent in known amounts. In the Lovibond tintometer the colour of the food sample is matched with a series of colour slides. The Munsell tristimulus system uses combinations of coloured discs; it is often used but tedious to operate. However, values obtained can be converted to CIE values. A reflectance attachment fitted to a spectrophotometer can be used to measure the light reflected from a sample at any wavelength. If the results have to be converted to CIE values, measurements have to be made at a large number of wavelengths for a particular sample and the process becomes laborious.

The most convenient and rapid method for measuring food colour is to use a tristimulus reflectance meter such as the Hunter Colour Difference meter. No human matching of colours is required. The instrument can be used for solids, pastes, purées and liquids, the last three being presented in a sample cup, with or without a white backing tile depending on the transparency of the sample. The meter gives three readings for any sample:

L...lightness, 0=black, 100=white
'a'...0 to+100 for red, 0 to-100 for green
'b'...0 to+100 for yellow, 0 to-100 for blue

The readings can be converted to CIE values if necessary. When giving results of colour measurements on this meter it is normally not necessary to quote values for L, a and b. Usually L or 'a' or 'b' or a ratio of L:b or a:b will suffice. This can be decided by correlating L, a, b values and their ratios with panel response for a particular colour. The data in Table 1 show the scales (L, a, b or ratios) found suitable at Kinsale Research Centre for various fruits, vegetables, jams, etc. and also Hunter meter values for extremes of colour in these products. Various colour acceptability levels can be decided upon (based on visual panel assessments). For example, fresh mushrooms for sale at wholesale level should have an L value >80; cauliflower with an L:b ratio of <3.00 is not suitable for freezing; carrots for bottling should have an 'a' value +30; white wine with an L:b ratio +2.0 is too dark, etc.

<table>
<thead>
<tr>
<th>Product</th>
<th>Hunter scale</th>
<th>Visual range</th>
<th>Range of values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mushrooms</td>
<td>L</td>
<td>white—brown</td>
<td>95–70</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>a/b</td>
<td>turning red—deep red</td>
<td>0.85–2.00</td>
</tr>
<tr>
<td>Apples</td>
<td>±a</td>
<td>green—red</td>
<td>-12 to +25</td>
</tr>
<tr>
<td>Carrots</td>
<td>+a</td>
<td>light to deep orange</td>
<td>12–38</td>
</tr>
<tr>
<td>Pickled beetroot</td>
<td>+a</td>
<td>deep red—red</td>
<td>10–15</td>
</tr>
<tr>
<td>Cauliflower florets</td>
<td>L/b</td>
<td>white—creamy</td>
<td>4.70–2.80</td>
</tr>
<tr>
<td>Strawberries</td>
<td>L</td>
<td>red flesh—white flesh</td>
<td>35–57</td>
</tr>
<tr>
<td>Strawberry jam</td>
<td>L</td>
<td>red dark—light red</td>
<td>7–12</td>
</tr>
<tr>
<td>White wine</td>
<td>L/b</td>
<td>light to dark yellow</td>
<td>4.00–1.66</td>
</tr>
<tr>
<td>Salad cream</td>
<td>+b</td>
<td>yellow to white</td>
<td>24–16</td>
</tr>
</tbody>
</table>

*Values are based on tests at Kinsale Research Centre on a large number of samples.