David Berryman Founder, David Berryman Limited

The use of fruit juices as natural colouring agents

It's fairly well established that we eat with our eyes. Before we even attempt to taste food, our brains need the comfort that what is about to be consumed has passed a visual test. As omnivorous creatures, the range of colours which we recognise as attractive is vast. What is regarded as a 'good' colour for fruit may not be a good colour for meat or fish, but we have learned by association to edit incoming visual data.

It is probably not surprising, therefore, that the colours sector of the modern food industry has become very important. Colour producing companies are high-tech and sophisticated. And in the 21st century, their Holy Grail is naturalness.

As an ingredient producer, not a pigment manufacturer, David Berryman Limited is a customer of the colour companies. This article aims to provide an overview of our experiences using our most basic of ingredients – red fruit juices – to enhance or change the

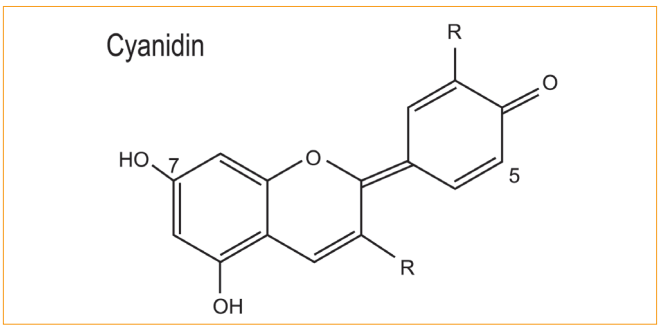

Figure 1: Cyanidin is perhaps the most common anthocyanin (red pigment) in red fruits, as shown in the profiles for aronia, raspberry, elderberry, sour and sweet cherry, where Cyanidin predominates

colour of our recipes. We will examine which red fruit juices are the most popular; the colours in the juices; whether there is a connection between taste and colour; and juices in water, yoghurt and soya bases.

We examined the following concentrated fruit juices:

- Aronia (Chokeberry) (*Aronia melanocarpa)*
- Blackcurrant (*Ribes nigrum)*
- Blackberry (*Rubus fruticosus)*
- Red Grape (*Vitis vinifera)*
- Sour cherry (*Prunus cerasus)*
- Elderberry (*Sambucus niger)*
- Raspberry (*Rubus idaeus)*
- Strawberry (*Fragaria ananassa)*

The colours in the juices – variations on a theme

The pigments in red juices have been investigated in depth for many years. The colour of our chosen fruits and their juices is determined by a group of compounds probably best described as 'short chain polyphenols' – anthocyanins.

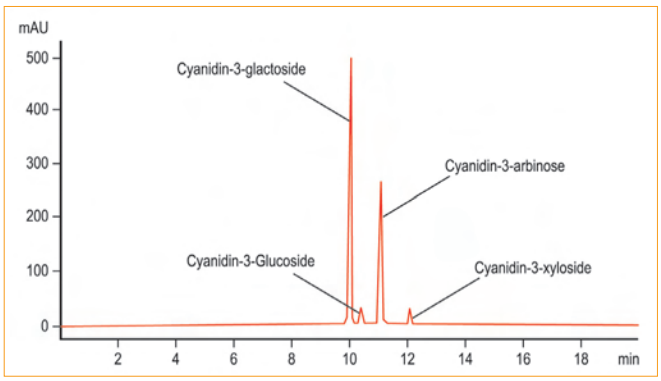

Figure 2: Aronia anthocyanins

The basic model for the anthocyanins is one of three phenolic groups as illustrated in **Figure 1**. The shape of this basic molecule is changed depending on which radicals have been added. This is illustrated in **Figures 2-8**, where the most common anthocyanins are listed, each of which has its own distinctive colour.

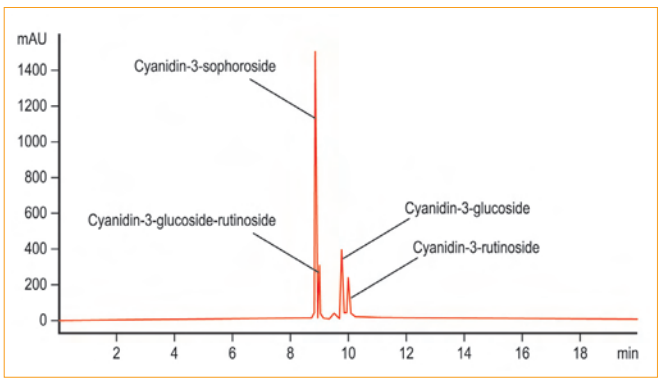

Figure 3: Raspberry anthocyanins

As one might anticipate in the orderly maelstrom which exists in all living cells, the colour of fruit is quite complex. It would be so convenient if one could say that each of the fruits had its own particular anthocyanin. Then it would be a simple exercise to ascribe the distinguishing colours which the fruits exhibit to a single pigment. But the fruits we collect from trees today are the result of many millions of years of evolution. Whilst it is true that a single anthocyanin may predominate in any one particular juice, the final colour is decided by a whole range of red molecules. Just as with an artist's pallet, the colour we see is the result of subtle mixing of molecules.

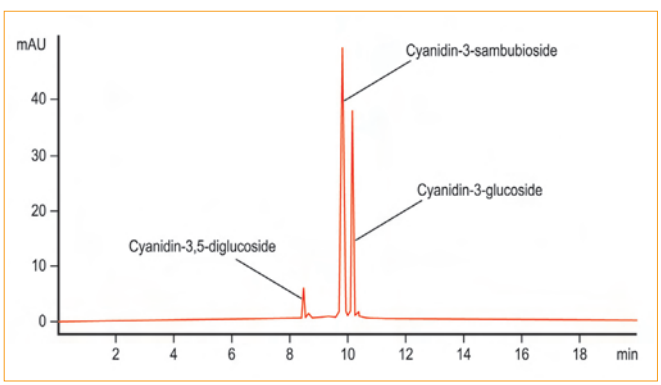

Figure 4: Elderberry anthocyanins

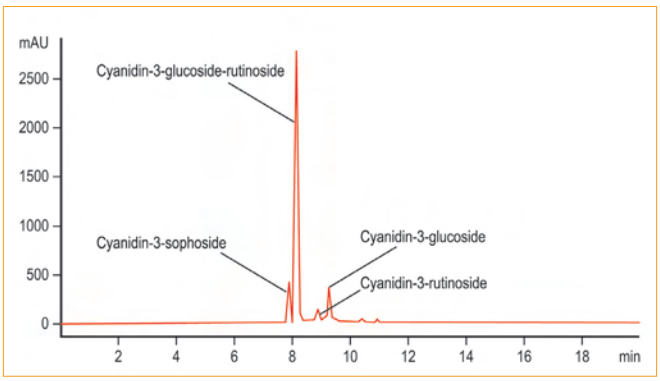

Figure 5: Sour cherry anthocyanins

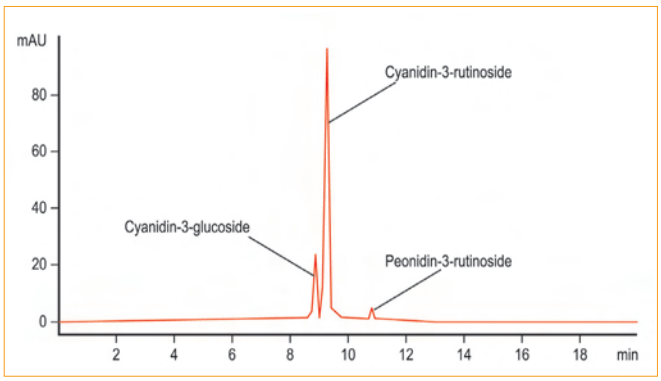

Figure 6: Sweet cherry anthogyanins. As with sour cherry, cyanidins are in the majority but the presence of Peonidin gives this juice a different hue

Indeed, the particular hue we see can also be illustrated as a 'fingerprint' when analysed by gas liquid chromatography, which is a very neat way of demonstrating why the fruits have such an array of shades from red to blue to black.

Cyanidins are the most common and dominating anthocyanins in red juices. The huge range of colours which we see is a reflection, to a large extent, of the different types of cyanidins in various red fruits. In some cases, such as sweet cherry and blackcurrant, the presence of other anthocyanins can be regarded as a distinguishing marker for that particular juice.

In the juices which are under discussion the main anthocyanins are cyanidins with pelargonidin, delphinidin and peonidin being variations on this basic model.

Whilst it is true that a single anthocyanin may predominate in any one particular juice, the final colour is decided by a whole range of red molecules

The balance between taste and colour

Anthocyanins are a direct product of photo-synthesis, the process used by plants to harness energy from sunlight. In fact, these red pigments are produced from flavonoids, which are usually yellow in colour and, unlike anthocyanins, have a distinctive flavour. So flavonoids are the precursors of anthocyanins. Flavonoids have a flavour whereas anthocyanins generally have no taste.

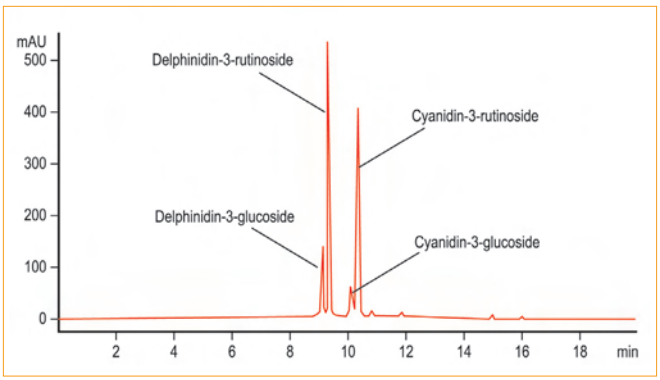

Figure 7: Blackcurrant anthocyanins. The presence of Delphinidins in blackcurrant makes this anthocyanin an important marker and is a reason for the particular blackcurrant pigment

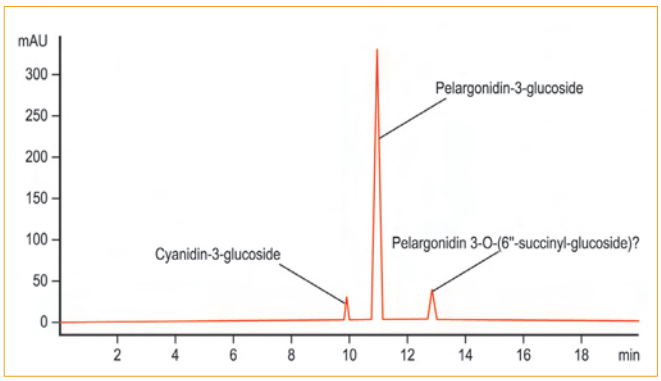

Figure 8: Strawberry anthocyanins. Pelargonidin dominates the anthocyanin spectrum for strawberry giving this juice its very distinctive scarlet colour

Consequently, the molecules responsible for the flavour of the juice and the colour of the juice are often found alongside each other in the fruit. It means that if a manufacturer of recipes wishes to use a juice to colour an ingredient, then the effect of the taste must also be taken into account.

However, this is not always the case. The reason for fruits having bright colours such as red as part of their make-up is to attract birds and other animals. It is their way of spreading seeds around the countryside. Consequently, for many red fruits, the pigments are only skin deep, as shown in **Figure 9** (page 29). It is legend, of course, that in ancient Rome, a decadent master would ask his slave to "peel him a grape". It was a way of by-passing the skin which is rich in anthocyanins, but has little taste, to get to the succulent flesh which is crammed with flavonoids, which are full of flavour.

It is no accident that probably the first use of anthocyanins as a natural colourant was in Italy when red grape skins, from the wine industry, not the whole fruit, were used in the confectionary industry.

Using juices in ingredients

Although David Berryman Limited now regards itself as an ingredients manufacturer and supplier, the company's origins are as a fruit juice company. Consequently, many of its recipes are fruit

based and we use fruit juices for both colour and flavour, sometimes together and sometimes separately.

We conducted a very straightforward demonstration of how juices behave in different circumstances and made five per cent juice recipes with water, soya milk and yoghurt.

As we would have anticipated, each juice changed colour as a reaction to such things as pH or presence of proteins. Anthocyanins, just as with litmus indicator, can change from bright red to blue depending on the pH. The colours are demonstrated in Figure 10).

So we can see that the best juices to use as colouring agents are blackcurrant, elderberry and aronia. However the taste of blackcurrant is very strong and so generally elderberry and aronia would be used in cases where fruit flavour was not required. Raspberry, strawberry, sour cherry and blackberry would not make particularly good pigments and in addition their flavours are quite distinctive.

Our R&D department produces several thousand recipes a year using the various characteristics of red juices which can form the basis of many fruit compounds and preparations.

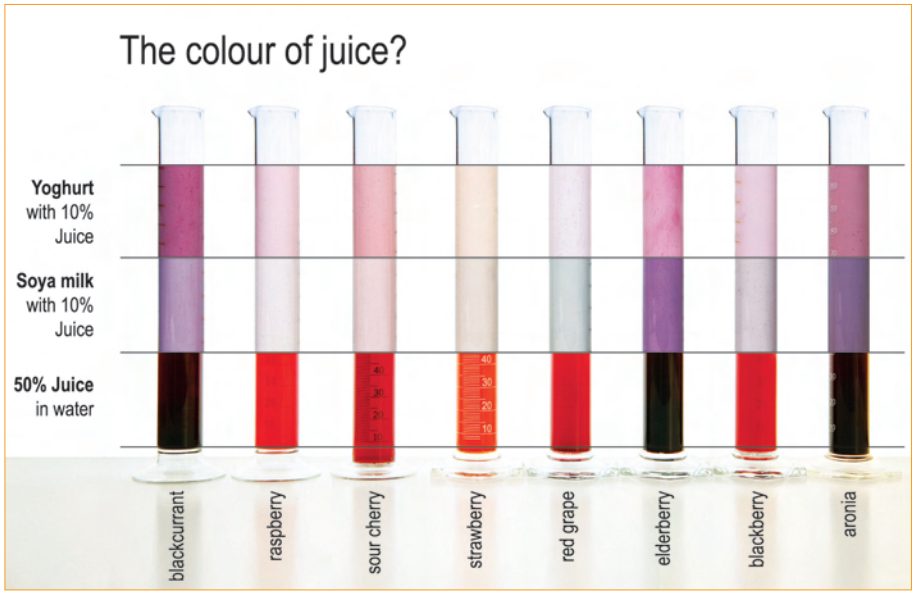

Figure 10: The colour of different flavoured juices as a reaction to pH and/or presence of proteins

Figure 9: This photograph of a peeled red grape shows that the red pigment which gives the grape its colour is only skin deep

About the Author

David Berryman began his career in pharmaceutical research and founded David Berryman Limited (DBL) 27 years ago. In 1997, the company launched the first Fruit Juice Factory dedicated to blending in the UK. Innovation has been the key driving force of DBL and during that time and new developments each year have radically changed the face of the company. DBL has become a leading innovator in the food industry, now producing over 3,000 new recipes each year in, for example, the dairy, ice cream, bakery, confectionery and the soft drinks sectors.