

Why do black berries often stain bird faeces?

Several plant species produce deep black or purplish-black fruits. The colour of these fruits is usually due to a concentrated solution containing Anthocyanins in the cells of the epicarp or pericarp of these fruits. Anthocyanins are easily hydrolysed to Anthocyanidins, but these too have deep colours. The Anthocyanidins produced by the breakdown of the tissues of black fruits are usually deep purplish violet. It is the high concentration of pigment which makes the fruit appear black.

An Anthocyanin is a glycoside of an Anthocyanidin. For instance, the blue colour of Delphiniums is due to the Anthocyanin, Delphinin. This consists of a single molecule of Delphinidin linked to two molecules of Glucose and molecule of 4-hydroxybenzoic acid (Finar 1968). The Anthocyanins are water soluble and readily diffuse out of damaged cells. The Anthocyanidins are not digested inside the avian intestine and emerge in the faeces.

The black fruits of Ivy *Hedera helix*, Mediterranean Buckthorn *Rhamnus alaternus*, and Blackberry *Rubus fruticosus* generally produce a purple to violet colouration in the faeces of birds which eat them. The presence of uric acid crystals in the faeces generally makes the pigment more conspicuous by diluting it and presenting it against a white background.

The study of avian frugivory is still in its infancy and we do not yet understand why fruits are coloured black, red, yellow, white, green etc, rather than their all being one colour (Snow & Snow 1988). In this short communication, it is suggested that the black colour of some fruits is intended to result in staining of the faeces. This may be one function of the pigment which is responsible for the black colour.

Why should it be advantageous to the plant to stain the faeces of its avian frugivores? Generally, an avian community will contain many species which are potentially frugivorous, and many of these birds will be utilising the same areas. Doubtless, these birds encounter one another's droppings frequently while foraging on vegetation. The purplish-violet stains in the faeces must be as conspicuous to the birds as they are to us, and it is reasonable to suppose that given the high intelligence of birds, the message conveyed to the bird is the same. The message conveyed is that somewhere in the vicinity there are black fruits which another bird has been feeding on. Black fruits are usually more difficult to detect than red fruits of the same size, particularly against a green background and at a distance (Snow & Snow 1988; pers obs.). One way of inducing birds to seek the fruits of a particular plant is by advertising the availability of fruits of that colour. All the bird has to do is look around for fruits of the appropriate colour in the general vicinity.

Perhaps fruits which are coloured red are intended to attract birds to the fruiting tree by virtue of their being visually conspicuous. Such fruiting trees can often be made out at a distance, provided that there are many fruits on the tree. The visual signal is less effective if the fruits are small or if there are only a few fruits. Thus if a tree is unable to produce many, large fruits, it might pay to produce black rather than red fruits. The black fruits stain the faeces of the few birds which start eating the fruit initially, and this alerts other birds to the availability of the fruits. Thus, a plant producing black fruits which stain the faeces, needs to produce fewer fruits in order to disperse a given number of seeds. Birds will seek out the black fruits even when they are rare and not conspicuous at all.

Fruits which are red when unripe and then turn black when ripe might be utilising a mixed strategy of fruit advertisement. The red colour makes the unripe fruits conspicuous and birds can make a mental note that fruit will be available there in the near future. The appearance of stained faeces in the vicinity serves as a reminder to the bird that the fruit which it noted earlier is now ripe. Given this information and thorough knowledge of the geography of its territory (see Shettleworth 1983), the bird would know where to look for fruit.

Thus, staining of faeces by pigments present in fruit seems to be a factor which might have affected the coevolution of fruit bearing plants and their avian frugivores.

References

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