Birds- Pigments and Colours

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Birds- Pigments and Colours

Pigments are chemical compound responsible for colour, range from animal to animals. Pigment absorbs some of the light they receive and then reflect only certain wavelength of visible light, due to which animals appear colourful.

Chromatophores

Each colour is indicated by the three types of chromatophore cells:

a. **Erythrophores:** contains reddish pigments such as carotenoids and pteridines.
b. **Melanophores:** contains black and brown pigments such as the melanins
c. **Xanthophores:** contains yellow pigments in the forms of carotenoids

The various colours are made by the combination of the different layers of the chromatophores. These cells are usually located beneath the skin or scale the animals.

There are two categories of colours generated by the cell.

a. **Biochromes** are colours chemically formed microscopic, natural pigments. Their chemical composition is created to take in some colour of light and reflect the rest.
b. **Schematochromes** (structural colours) are colours created by light reflections from a colorless surface and refractions by tissues. Schematochromes act like prisms, refracting and dispersing visible light to the surroundings, which will eventually reflect a specific combination of colours.

These categories are determined by the movement of pigments within the chromatophores. The physiological colour changes are short-term and fast, found in fishes, and are a result from an animal's response to a change in the environment. In contrast, the morphological colours change is long-term changes, occurs in different stages of the animal, and are due to the change of numbers of chromatophores.

Animal pigment - pigment occurring in animals

1. **Bilirubin, haematoidin, hematoidin** - an orange yellow pigment in the bile that forms as a product of hemoglobin; excess amounts in the blood produce the yellow appearance observed in jaundice
2. **Urobilin**-
   brown bile pigment formed from urobilinogens and found in feces and in small amounts in urine

3. **Luciferin** - pigment occurring in luminescent organisms (as fireflies); emits heatless light when undergoing oxidation
4. **Melanin** - insoluble pigments that account for the colour of e.g. Skin and scales and feathers

Respiratory Pigments

a. **Chlorocruotin** - two families of marine polychaetes (Serpulidae and Sabellidae)
Fe-containing protein
Green in both deoxygenated and oxygenated states

b. **Hemocyanin** - gastropods and cephalopods, crustaceans, arachnids, and horseshoe crabs
Cu-containing protein,
Blue in deoxygenated state, colorless or white in oxygenated state
Never present inside cells, but always in suspension in blood

c. **Hemerythrin** - sipunculids (peanut worms), polychaetes, priapulids, and branchiopods
Fe-containing protein,
Brownish in deoxygenated state, purple in oxygenated state

d. **Hemoglobin** (Hb) - all vertebrates and many invertebrates (most annelids, nemerteans, phoronids, and echiurids)
Fe-containing protein,
Dark red in the deoxygenated state, bright red in the oxygenated state

Some other pigments in invertebrate

1. **Pinnaglobin**—a brown coloured manganese containing pigment found in the plasma of Pinna (Lamellibranchs).
2. **Vanadium**—It is a green coloured vanadium containing pigment found in the vanadocytes of some sea squirts (Ascidians).
3. **Molpadin** pigment is present in Holothurian Molpadia
4. **Echinochrome** is known in sea urchins of echinoderms.

Foods - Change Birds' Colours

The colouration of birds comes mainly from three groups of pigments:

1. Carotenoids
2. Melanins
3. Porphyrins

1. **Carotenoids:** Carotenoids are compounds of plant origin (only produced by plants and algae), which implies that if a bird has carotenoids in its feathers it is because it has fed on plants that contain them, or on animals that had previously ingested them.

Credit: ***Pedro Szekely***

Once assimilated, these carotenoids travel through the bloodstream to reach the dermal follicles from which the feathers develop; these follicles supply the growing feathers with blood and with colour. Carotenoids are the pigments responsible for the yellow, orange and red tones, in addition to different shades of green, such as olive, when combined with melanins.

2. **Melaninas:** Pigments that (including birds) can produce themselves by animals: the melanins, which generate different tones of black, brown, grey, earth. They are the same type of substances that also produce the different skin tones and colours exhibited by humans. Some examples of birds that owe their coloration to melanins are the real owl or the golden eagle.

The golden eagle owes their coloration to melanins.
Source: ***Pxhere***

Melanins are produced inside specialized cells, called melanocytes. It is the only plumage colouring mechanism that is genetically encoded and is controlled directly at the cellular level. The genetic code hides the complex patterns of the plumage of many birds. These colourful designs are expressed by modulating the presence, location, concentration, differentiation and even activation of the melanocytes in the follicles in which the feathers develop.

3. **Porphyrins:** Porphyrins are responsible for the vibrant pinks, reds, browns and greens of many gallinaceous species (such as the peacock) and pigeons. **Psittacofulvin** and **turacin** are pigments that are even more exclusive: the former only appear in the order *Psittaciformes* (birds typical of the tropical regions, like parrots, cockatoos and macaws); the latter is typical of turacos. Both pigments are the origin of the intense greens and reds that distinguish these birds.

Turacin is responsible for the colors of turacos.
Source: ***Pxhere***

These three types of pigments are exceptional for three reasons:

a. for their bright and intense colours, because they are unique to a few groups of birds and because these birds synthesise them after having developed specific processes.
b. Following these metabolic pathways, the most exotic birds modify the structure of carotenoids, and therefore their

colour, to generate porphyrins, psittacofulvins and turacins.

c. Thus the presence and influence of these special pigments also depends on the availability of foods rich in carotenoids.

Source https://www.bbvaopenmind.com/en/science/bioscience/the-secret-behind-the-colourful-plumage-of-birds/

Suggestive Reading

1. Biology of Chordata By H. C. Nigam
2. Text Book of Vertebrate Zoology By J. S. Kingsley
3. The Life of Vertebrates By J. Z. Young
4. A Text-Book of Zoology Vol. II By Parker and Haswell
5. https://www.biologydiscussion.com/animals-2/blood-animals-2/pigments-found-in-the-blood-of-animals/33322