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Of earwax and migration

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The month of February is usually dedicated to romanticism. We, however, shall dedicate it to the intricacies of earwax. Less charming, perhaps, but just as rich. We are all acquainted with the yellowish/brownish soft substance which lines our inner ear. Regarded mainly as dirt, we spend our time extracting it. Yet there is good reason for it to be there. And one of the reasons is the existence of cerumen apocrine glands in the external auditory canal, which secrete cerumen along with a host of other biomolecules. Secretion demands canals and pumps. And one protein pump – the multiple drug resistance protein 8 (MRP8) – has a direct role not only in the production of earwax but also in its texture.

What is earwax for? Earwax and cerumen are commonly used as synonyms. However, cerumen is the wax, *per se*, secreted by the cerumen glands in our ears. And earwax is a mixture of cerumen, dead skin, sweat and oil. No one is sure what earwax is for but it does participate in a number of tasks such as keeping the eardrum flexible, forming a natural barrier to insects or indeed repelling them with its bitter taste, as well as warding off infection and bestowing upon our inner ears resistance to water. Though many people suffer from too much earwax – which can impair their hearing and even increase the possibility of infection – ears do not need to be cleaned… They do it themselves.

Besides Shrek who extracted such a huge hunk of earwax that he was able to fashion a candle with it, there has been little use or mention of earwax in the past. A study on medieval technology, the earliest copy of which dates back to the 8th century AD and is known as the *Mappae Clavicula*, recounts the use of earwax in the process of manuscript illumination. The illumination of medieval texts consisted in introducing bright and shiny colours to pictures and ornamental letters before the age of printing machines. For this purpose, pigments were bound with various ingredients such as honey, egg-tempera, gum-arabic and…earwax.

As mentioned, cerumen is secreted by cerumen glands in the inner ear by way of biological pumps: the multiple drug resistance proteins. These are organic anion transporters which are involved in eliminating all sorts of endogenous substances from the body. In particular, MRP8 (also known as ABCC11) is a protein about 1500 amino acids long with 12 transmembrane domains and 2 ATP-binding sites, suggesting that it is lodged within the cell membrane and uses ATP as fuel in the pumping process. MRP8 not only drains purine and pyrimidine nucleotide analogues such as cAMP and cGMP, but it can also transport lipophiles. Earwax is loaded with lipid content and there is therefore a great chance that wild type MRP8 is involved in producing the goo in our ears.

Titeuf, one of Switzerland's heroes

Everyone has earwax. But not everyone has the same kind. Asians have what is termed 'dry earwax' or 'rice-bran earwax' which is…dry, i.e. its lipid content is very low – barely 20% – so most of it is made up of keratin and other waste. The rest of the world produces 'wet

earwax', whose lipid content reaches 50%. Astonishingly, this dry/wet earwax trait is handed down in a Mendelian fashion. The dry earwax trait is recessive; the wet earwax phenotype is dominant. Populations which inherit two dry earwax alleles – for the great majority, the Chinese and the Koreans – produce dry earwax. In effect, they produce very little cerumen because of pumps which are not so efficient as their wet earwax counterparts.

Such a phenotype is very informative in population genetics and in the tracing of human population migration in the past. Indeed, the recessive trait seems to have arisen in North East Asia from where it spread further East still. Intriguingly, North American Indians are also the bearers of dry earwax. Though in the light of human migration towards the Americas via Asia and the Bering Straits thousands of years ago, this hardly seems surprising.

Why the difference? Why do some human populations have dry earwax whilst others have wet earwax? What is the advantage of one over the other? One hypothesis is based on climate change. As humans migrated towards the North and the East, the climate became gradually colder. A core of compact wax might have kept our ancestors' ears from freezing. The choice of wax versus powder may also have something to do with sweat glands. Cerumen glands are in many ways similar to our axillary sweat glands. And not only are they similar but they also seem to be related. In colder climates, it is imperative to find ways of losing less heat. And one effective way is to stop sweating. Selectivity could have operated on the axillary glands as humans migrated towards the cold, and it may be that such selective pressure ultimately had an effect on the cerumen glands.

It sounds far-fetched yet there do seem to be instances in which diseases are related to the malfunction of apocrine glands… Take the case of a Japanese woman who suffered from a rare neurological disease – paroxysmal kinesigenic choreoathetosis – which caused her extremities to make uncontrollable twisting movements. This woman had wet earwax, as did six other members of her family, which is an unusual occurrence in Japan. A number of scientists also suggest a possible association of earwax type with armpit odour and even breast cancer susceptibility. Indeed, the axillary, cerumen and breast glands are similar in function and could be related one way or another.

Time will tell. So far, no direct correlation has been made between earwax and any disease. Besides its use in the techniques of medieval illumination, it just seems to be there to help scientists track our ancestors' route around the planet. Although the French author Gustave Flaubert (1821-1880) did give it a special mention in his 'Dictionary of received ideas', in which he would jot down the most boring quotes he had ever heard. One of them being: 'Human wax. Should not be removed as it keeps insects from entering the ears.'

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