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How black truffles deal with the jumpers in their genome

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The black truffle uses reversible epigenetic processes to regulate its genes, and adapt to changes in its surroundings. The 'methylome' - a picture of the genome regulation taking place in the truffle, is published in the open access journal *Genome Biology* and illustrates how the truffle deals with its complex genome's repeating elements and 'jumping genes'. The authors say this may shed light on how traits like aroma and colour are controlled.

Black truffles (*Tuber melanosporum*), also known as Périgord truffles, have a syrupy sweet flavor and are highly prized in haute cuisine. They are fungi that grow on the roots of oak and hazelnut trees, and are the second most expensive truffle species. More than 58% of the 125 Mbp black truffle genome is made up of repetition and 'jumping genes' - sections of DNA which can move about within the genome.

DNA methylation is a heritable epigenetic modification of the genes, where a methyl group is added to cytosine DNA nucleotides. It is involved in regulating many genetic processes, and scientists analyse methylomes to get a genome-wide picture of it.

Scientists at UCLA and the University of Parma measured the proportion of cytosines that were methylated in the black truffle genome at various developmental stages: fruitbody - the sexual stage and the actual truffle, free living mycelium - the fungus on its own, and ectomycorrhiza - the fungus living together with tree roots.

They found a high rate of methylation - 44%. Transposon element sites were far more likely to be methylated than genes, which tended to be demethylated. They found the methylation could be partly reversed by treatment with 5-azacytidine, an analogue of cytidine, resulting in the reactivation of certain transposons.

Dr Simone Ottonello, from the University of Parma, Italy says: "If extended to black truffles from different geographic areas, epigenomic analyses, such as the one described in this work, may shed light on the relationships between DNA methylation and transposon-mediated genome shaping, intraspecific variability and commercially relevant organoleptic traits such as aroma and color"

Dr Matteo Pellegrini, from UCLA says: "This reversible methylation may increase the plasticity of the truffle genome, allowing it to adapt to its surroundings. Because the truffle lives underground and doesn't have an active spore dispersal system, it might need this plasticity to adapt to sudden environmental changes."

Dr Pao-Yang Chen, from UCLA says: "Instead of the methylated gene body or promoters that we usually see in plants and animals, the black truffle has very little gene body methylation and it appears that the methylation is occurring in the transposon. All this means the truffle has a very unique pattern of DNA methylation which may play a role in the gene regulation."

More information: *Genome Biology* 2014 15: 411. genomebiology.com/2014/15/8/411/abstract

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