



# Genome-wide identification, phylogenetic relationships, and expression analysis of the carotenoid cleavage oxygenase gene family in pepper

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**ABSTRACT.** Carotenoid cleavage oxygenases (*CCOs*) are a family of dioxygenases, which specifically catalyze the cleavage of conjugated

double bonds in carotenoids and apocarotenoids in plants. In this study, genome-wide analysis of *CCO* genes in pepper plants was performed using bioinformatic methods. At least 11 members of the *CCO* gene family were identified in the pepper genome. Phylogenetic analysis showed that pepper and tomato *CCO* genes could be divided into two groups (*CCDs* and *NCEDs*). The *CCD* group included five sub-groups (*CCD1*, *CCD4*, *CCD7*, *CCD8*, and *CCD-like*). These results indicate that there is a close genetic relationship between the two species. Sequence analysis using the online tool, Multiple Expectation Maximization for Motif Elicitation (MEME), showed that the *CCO* proteins comprise multiple conserved motifs, with 20 to 41 amino acids. In addition, multiple *cis*-acting elements in the promoter of *CCO* genes were identified using the online tool PlantCARE, and were found to be involved in light responsiveness, plant hormone regulation, and biotic and abiotic stresses, suggesting potential roles of these proteins under different conditions. RNA-seq analysis revealed that the *CCO* genes exhibit distinct patterns of expression in the roots, stems, leaves, and fruit. These findings suggest that the *CCO* genes have important roles in the vegetative and reproductive development of pepper plants.

**Key words:** Carotenoids; *CCO* genes; Bioinformatics; Pepper