# A Predictive Genetic Test for Apple "Fresh Taste" Provides Strategies for Improved Breeding and Fruit Handling

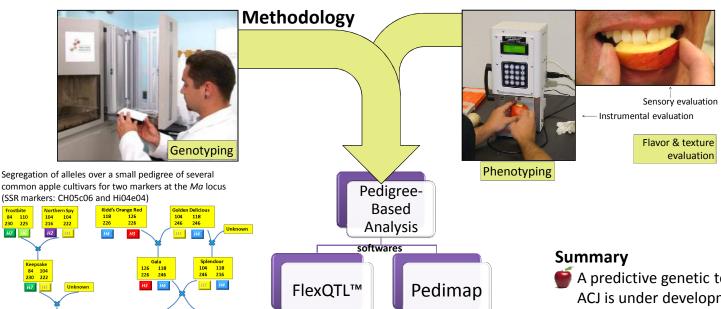
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## How do we improve apple fresh taste?

Introduction: Apple fresh taste includes acidity(A), crispness(C), and juiciness(J). Apple ACJ are major consumer-relevant traits, and according to RosBREED's socio-economics survey of breeders in 2010, apple ACJ are major target fruit quality traits for U.S. apple breeders(1). Apple fresh taste varies widely across cultivars and known to be under strong genetic control<sup>(2)</sup>. A specific genomic region called the Ma (Malic acid) locus, on apple chromosome 16, is highly associated with all three traits (ACJ)(2).

**Objective:** Develop a genetic test for apple "fresh taste" based on the Ma locus that is socio-economically relevant, predictive, accurate, user-friendly, and available to WA apple industry and breeding stakeholders.



"Haplotypes" describe alleles of the two Ma locus markers (CH05c06 and Hi04e04) that are usually inherited together. In between these two predictive markers is the gene(s) controlling the ACJ traits. Seven haplotypes have been differentiated so far, which can be used to predict the *Ma* locus functional allele between the markers. Any apple variety or tree carries two haplotypes – we can use the genetic test for these haplotypes to gain a rough prediction of acidity, crispness, and juiciness. At present, we have a preliminary test, and are further refining it.

Haplotypes at the <i>Ma</i> locus	Associated ACJ effects
H1	Tart
H2	Very tart
НЗ	Average ACJ
H4	Average ACJ
H5	Crisp and Juicy but bland
Нŝ	Bland
H7	Crisp, Juicy, and tart

- (1) "RosBREED: Enabling marker-assisted breeding in Rosaceae"
- (2) Liebhard et al. (2003) Plant Molecular Biology, 52:511-526

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- A predictive genetic test for ACJ is under development
- This genetic test will inform the Washington apple industry about genetic potential of new cultivars for ACJ performance like 'WA2' and 'WA5'
- This genetic test will inform apple breeders about the genetic potential of their germplasm



### Granny Goldrush Smith Pacific Queen Keepsake Golden Gala Pacific Rose Fartness → **Delicious** Splendour

Pedigree-Based QTL Analysis

Pink Lady o-op 15

Ladv

Williams

Northern

**Red Delicious** 

too tart!

Frostbite too bland! Crispness (and Juiciness) →

Plot above of "fresh taste" (tartness, crispness, and juiciness) and approximate haplotype effects calculated from a meta-analysis of cultivar performance in the Washington apple breeding program since 2004.