Tobacco

A Review by John C. Leffingwell, Ph.D.

This a part of our series on aroma materials produced by carotenoid degradation.

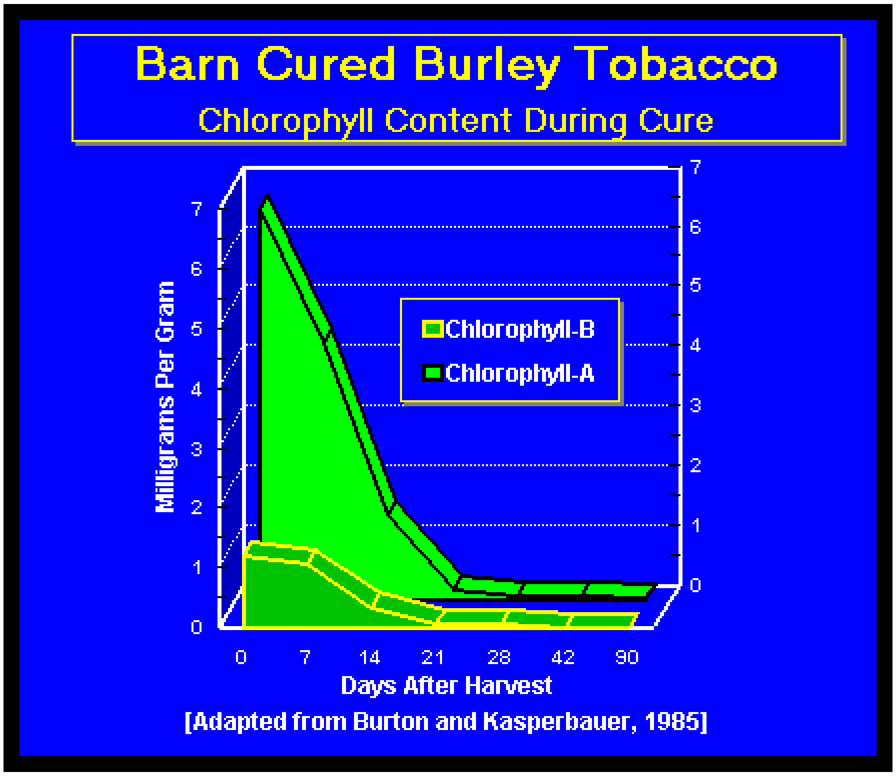
As plants mature, or die, the chlorophyllic pigments rapidly decrease and virtually disappear (one of the normal catabolic changes during plant senescence). This is shown below for Burley tobacco after harvest, but is undoubtedly similar for other (green) plants. Many of the same carotenoid degradation products found in tobacco are also found in osmanthus, saffron, rose, boronia, quince & grapes.

Cured Burley Leaf

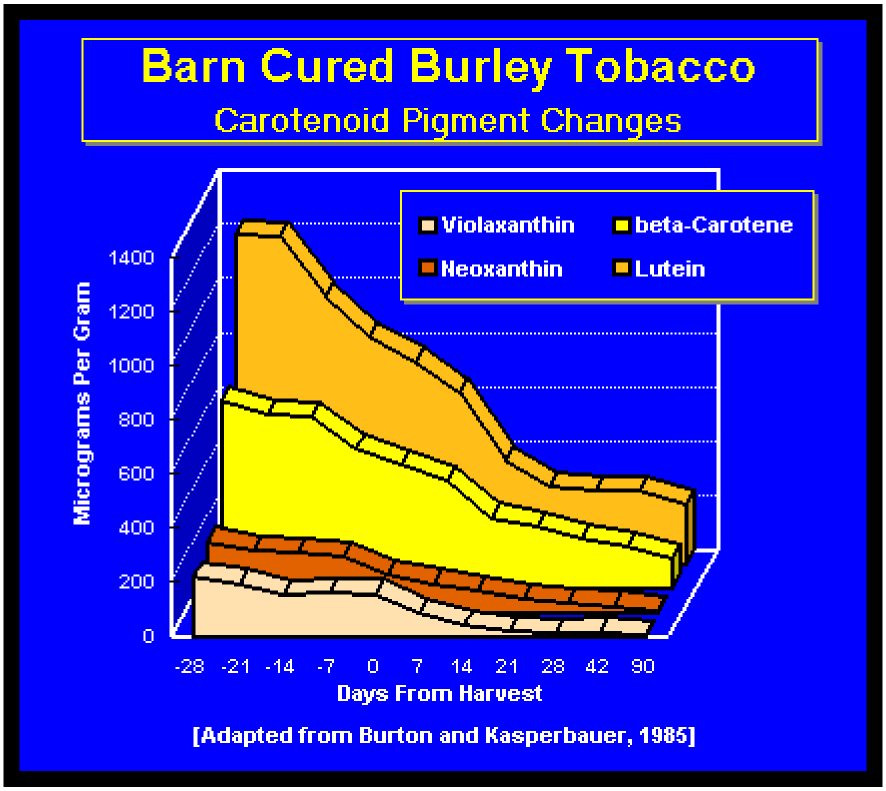
Nicotiana tabacum in flower

Cured Virginia Leaf

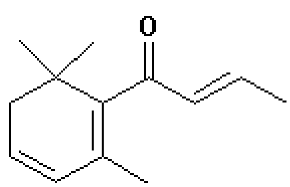
The graphs below show dramatically the transformation in pigments as plants die.



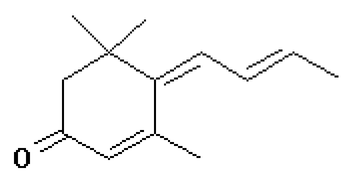
The yellow - orange carotenoid pigments of plants also decrease during the senescence or death phase of plants, but do not always decrease to the point of near extinction as do the chlorophyllic pigments. For example, using the same plant (tobacco) shown above...we see that the major carotenoids due not totally disappear. Much of the loss is due to enzymatic oxidative degradation. However, it should be noted that such oxidative degradation is also occurring during the life of the plant (not just in the death phase). In fact, photo-oxidation of carotenoids in living plants (i.e. flowers) is often responsible for its odor.



Many important carotenoid aroma constituents are formed during this decrease after harvesting and during the curing.
While no one or two components comprise the aroma of cured tobacco, the following constituents are reported as being important:



beta-Damascenone



Megastigmatrienones (4 isomers)

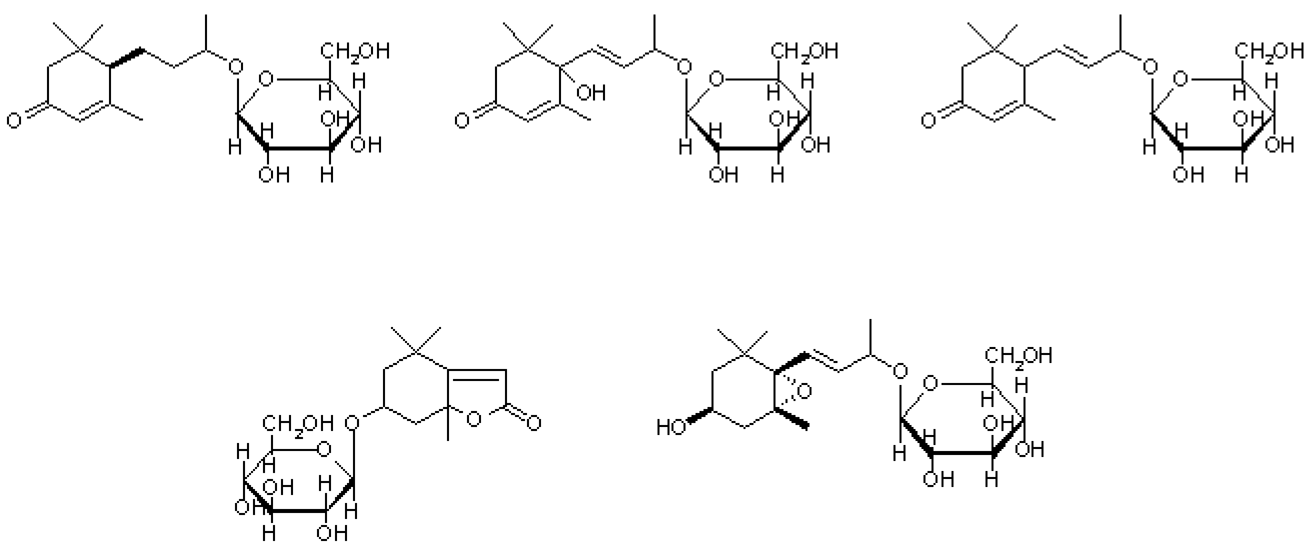
Undoubtedly due to health and social concerns, tobacco has been the most thoroughly researched natural product in history. We believe that well over U.S. 100 million dollars has been expended in the study of tobacco constituent composition. Over 2700 compounds have been identified in various tobacco varieties (Virginia, Burley and Oriental) and it is estimated that in excess of 6000 may be in tobacco smoke.

The study of tobacco constituents has identified seminal knowledge of importance to our understanding of plant constituents (e.g., identification and structural elucidation of the ubiquitous plant constituent, solanesol), the first identification of the class known as cembranoids, the finding that novel sugar esters in the leaf waxes act as both insect repellent and as the aroma precursor for Oriental tobacco, the discovery of 2-acetylpyrazine with its characteristic "popcorn" aroma, and especially to our knowledge of carotenoid degradation which is of importance to the flavor and aroma of many flowers and foodstuffs. In addition, our knowledge of genetic engineering was pioneered through use of the tobacco plant.

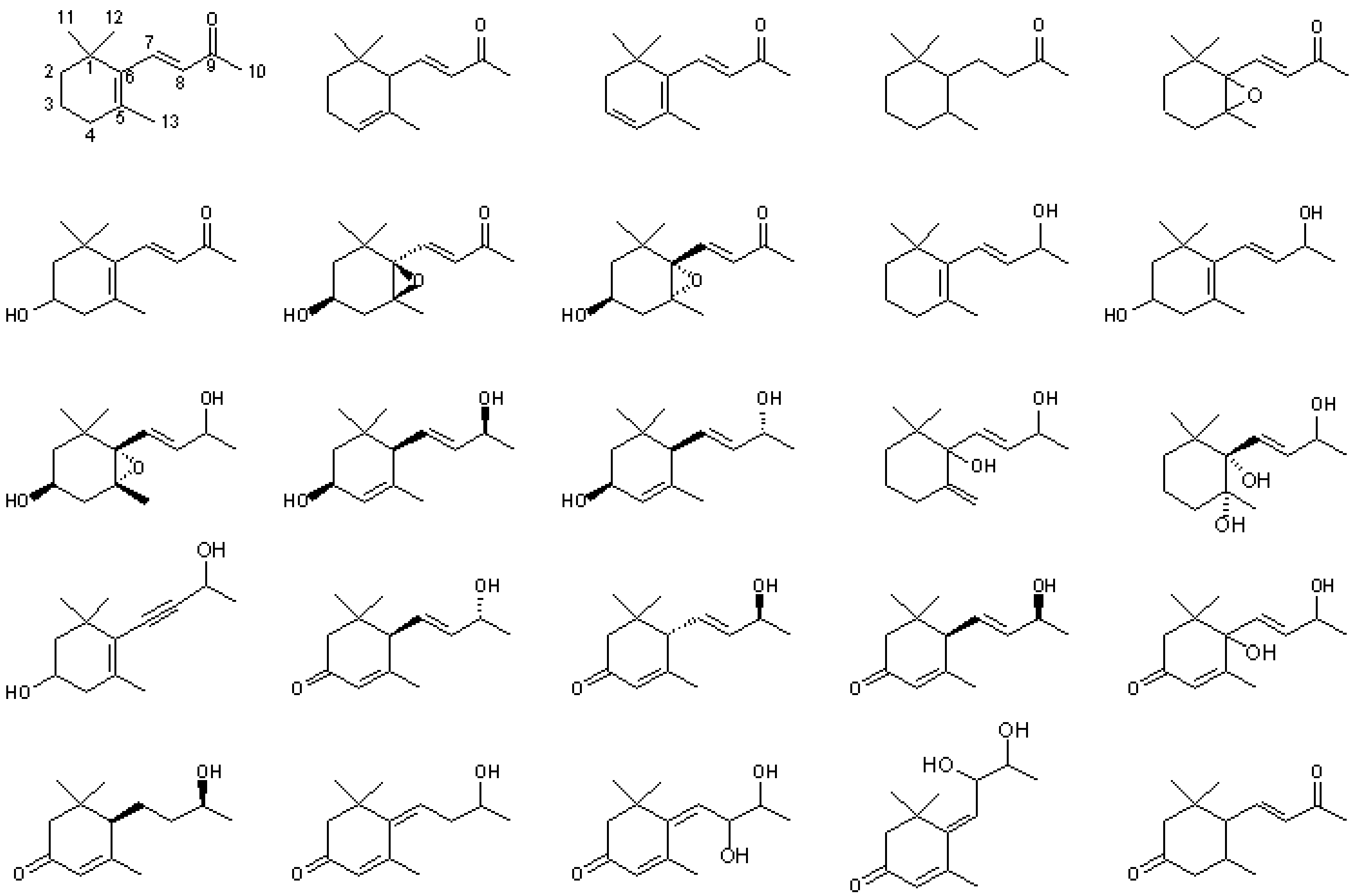
This review focuses solely on the aspect of potential aroma constituents produced by carotenoid degradation and does not touch on the many other classes of compounds in tobacco.

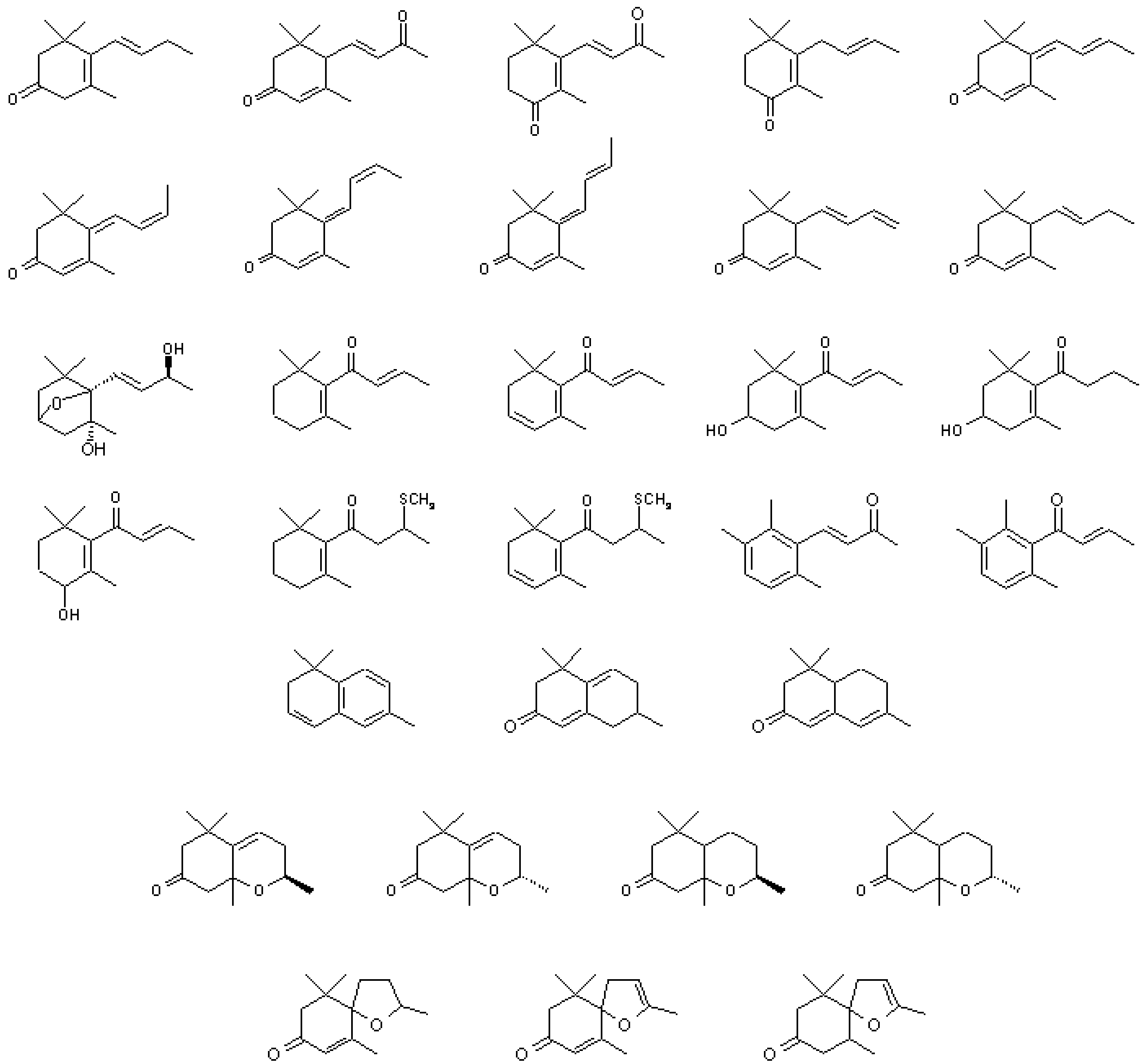
The following charts provide an overview of various aroma constituents produced in tobacco leaf via oxidative carotenoid degradation.

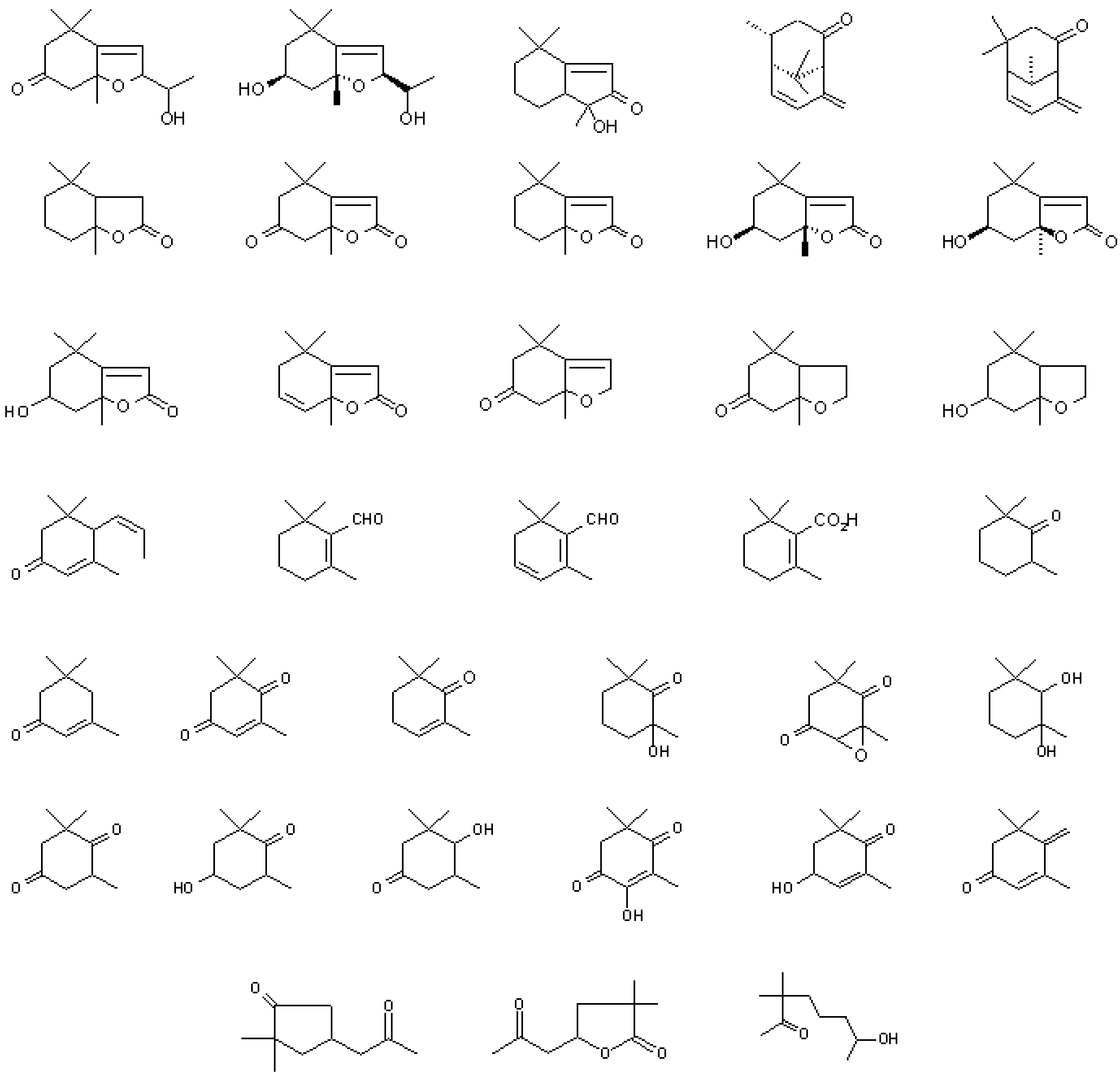
Glucosides of Carotenoid Derivatives in Tobacco



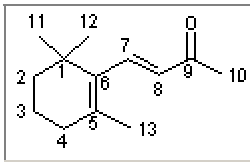
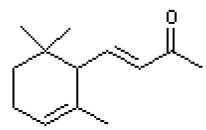
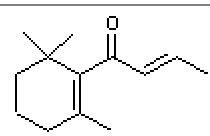
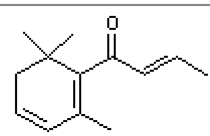
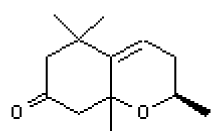
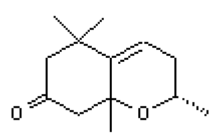
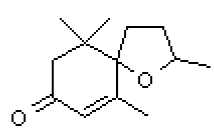
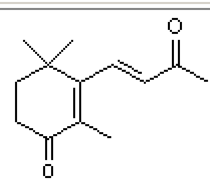
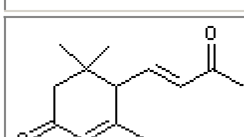
Carotenoid Derived Aroma Constituents of Tobacco

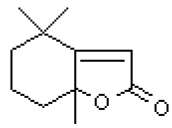
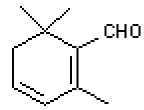
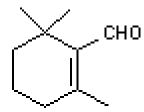






Aroma Properties of Selected Tobacco Carotenoid Derivatives

Name	Structure	Aroma Properties
beta-Ionone		Woody, violet, fruity; woody-raspberry on dilution
alpha-Ionone		Woody balsamic, violet-raspberry in dilution
beta-Damascone		Fruity (apple-citrus), tea-like with slight minty note
beta-Damascenone		Fruity, floral with apple, plum-raisen, tea, rose, tobacco note
Oxo-Edulan I		Oriental Tobacco like
Oxo-Edulan II		Oriental Tobacco like
Theaspirone		Tea like
4-Oxo-beta-ionone		Sweet rich like Virginia tobacco
3-Oxo-alpha-Ionone		Sweet, floral

Dihydroactinodiolide		Weak , slightly cooling
Safanal		Saffron, green, sweet, hay-like
beta-Cyclocitral		Green, grassy hay like odor

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Graphs adapted from Burton, H. R. and M. J. Kasperbauer, Changes in chemical composition of tobacco lamina during senescence and curing, 1. Plastid pigments, J. AGRIC. FOOD CHEM. 33, 879-883 (1985).

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