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PACKINGHOUSE NEWSLETTER

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SELECTION OF CITRUS 'WAX' COATINGS ON CRITERIA OTHER THAN SHORT-TERM GLOSS

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The primary value of systems thinking about the quality of fruits and vegetables is a greater emphasis on satisfying consumer needs and desires. Present systems appear to have developed primarily to serve the distributors and handlers, not to satisfy consumers.
S.E. Prussia and R.L. Shewfelt, 1993

Gloss, gloss and gloss. Conventional wisdom is that these are the three most important factors in selection of a citrus 'wax,' as the coatings applied to citrus are commonly called. The gloss of citrus fruit coming off the line is often the basis for purchase of coatings by packinghouse managers, because this also is often a main consideration in purchase by fruit distributors.

Are consumer needs and wants best served by the type of coatings presently used in packinghouses? Or do these coatings primarily serve the distributors and handlers of fresh citrus?

In order to address this question, let us consider the quality factors of coated citrus as these are related to composition of the coatings. This discussion will be limited to consideration of the major components of the coatings. For those interested in a more detailed discussion of composition, see the article by Hall (1981).

Although an over-simplification to say so, the citrus packer presently has a choice between two different types of coatings. First, there are the most popular resin solution coatings, whose main ingredients are shellac or wood resin. Second, there are the emulsion coatings, which consist of either carnauba wax or polyethylene wax. Resin solution and emulsion coatings have sometimes been called water waxes, as water is the main ingredient in the liquid formulations. These contrast with so-called 'solvent wax' which contains essentially no water. Solvent wax, which was at one time the most commonly used citrus coating in Florida, is no longer used in the U.S. because of cost, environmental regulations and safety.

Composition of the citrus coating is important, because it markedly affects the quality properties of the coated fresh fruit. First the coating composition relates to gloss.

Why is gloss important to the consumer? The most reasonable answer, often given, would seem to be that the consumer is more likely to purchase and enjoy eating fresh fruit if it is attractive in appearance. If so then it would seem one should select a coating that gives maximum gloss at time of purchase or consumption by the consumer, not necessarily when the fruit is freshly coated or when it is purchased by the distributor.

In our own research we compared commercial resin solution coatings with wax emulsions formulated in our laboratory, none of which contained any shellac or resin. Fruit gloss measured shortly after coating application was highest for resin coatings, as expected. However, the situation changed after storage. For example, after 2 weeks storage at 21 °C, grapefruit coated with any one of three different wax coatings had higher gloss than those coated with a commonly-used resin coating. Fruit gloss decreased with storage time for all of the coatings, but the rate of decrease for wax was only 20-50% that of the resin.

There are quality attributes other than gloss, starting with flavor, which can be adversely affected by the coating for reasons related to permeation of gases through the peel. The reason for this is that citrus fruit, like plant products in general, continues after harvest to respire, to take up oxygen and give off carbon dioxide. Unless these gases are able to pass through the peel without too much restriction, the carbon dioxide concentration builds up in the fruit and the oxygen becomes depleted. These changes can result in a change in the respiratory process so that off-flavors are produced, especially if oxygen is low when the fruit is not under refrigeration. For citrus fruit with shellac/resin coatings stored near room temperature the interior oxygen is often less than 4% and sometimes less than 0.5%, which is low enough to cause off-flavor. With wax coatings, oxygen content is generally several percentage points higher.

Low interior oxygen levels severely retard natural degreening, except for some mandarins such as Fallglo (Petracek and Montalvo, 1997). Low interior oxygen levels are also associated with postharvest pitting of several citrus varieties is also associated with low interior oxygen levels (Petracek, Wardowski and Brown, 1995). Poor flavor may result from low oxygen inside the fruit.

Fruit rind quality can also be affected, however. Postharvest pitting, a peel disorder, is currently a problem of major concern in Florida packinghouses. This disorder is most prevalent in citrus fruit stored without refrigeration (Petracek, Wardowski and Brown, 1995). Pitting has

been shown by Petracek and coworkers to be more common with resin rather than some wax coatings, possibly for the same reason resin coatings cause off-flavor, namely, they overly restrict the passage of gases through the peel.

Another important way coatings affect appearance is through their influence on the shrinkage caused by evaporation of water. By the time citrus fruit has reached 5-7% weight loss, it has become quite soft, and may exhibit stem-end rind breakdown. In general, the tendency of citrus fruit to shrink is quite dependent on the washing and waxing operations in the packinghouse. The greater the abrasion during washing, the worse the shrinkage, presumably because the natural waxes on the peel are removed and/or rearranged. The trend in the Florida fresh citrus fruit industry is to more extensive washing of the fruit to remove sooty mold, thus improving appearance. Thus, even more protection against shrinkage will be required. Although polyethylene emulsions perform about the same as resin with respect to shrinkage, other waxes are much more effective. Some wax coatings made in our laboratory reduced shrinkage by 75% relative to resin coatings.

Other appearance factors are of lesser importance than those just mentioned, such as the whitening that occurs when the coating is partially removed from the fruit when exposed to moisture or abrasion. Generally, such whitening (chalking or blush) is more common with resin coatings.

As mentioned, it is an oversimplification to classify citrus coatings as resin and emulsion types, because many coatings are mixtures of the two, varying from no resin to nearly 100% of the solids. Unfortunately, the buyer of commercial coatings may not be aware of and cannot see the level of resin in the formulation which might affect performance.

In summary, it would seem that citrus fruit that has been coated with wax emulsions containing less than about 10% resin may have properties better tuned to satisfy the consumer than fruit with coatings that have higher percentages of resin. The latter tend to maximize short-term gloss at the expense of long-term gloss, pitting, flavor and firmness in order to satisfy the demands of distributors and handlers.

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