# VOLCANIC ASH INFORMATION 8

Prepared by Oregon State University's Agricultural Experiment Station and Extension Service. For more information, consult the OSU Extension Service in your county or the nearest branch Agricultural Experiment Station.

July 1980

## CHERRY AND BERRY ASH PROBLEMS

TO: All Cherry and Berry processors in the state of Oregon.

Ash fallout has caused considerable difficulty for processors of fruits maturing at the present time. The fine particulate nature presents a problem because it readily embeds into soft, mature fruit, and also because of the iron and some other heavy metals which it contains.* Samples of ash collected at several points between Mt. St. Helens and Pullman, Washington were analyzed by Wozniak, Hughes, and Taylor at the Department of Geology, Oregon State University. The average analyses of these samples shows the following composition of mineral oxides:

| | Percent |
|---|---|
| Silica ($SiO_2$) | 64.0 |
| Alumina ($Al_2O_3$) | 18.0 |
| Iron oxide (Fe O) | 4.0 |
| Calcium oxide (CaO) | 4.5 |
| Potassium oxide ($K_2O$) | 2.0 |
| Magnesium oxide (MgO) | 1.5 |
| Sodium oxide ($Na_2O$) | 5.0 |
| Titanium oxide ($TiO_2$) | 0.5 |

The U.S. Dept. of Agriculture, based on ash analyses made at Fargo, North Dakota, reports the trace metal composition of the volcanic ash in ppm as follows: Copper (29), lead (62), zinc (13), cadmium (8), cobalt (8) and nickel (10). A particle size determination of the USDA sample found 75% smaller than 50 microns, 5% below 5 microns, and 2% less than 2 microns in size. 1 micron = 1/1000 millimeter.

Composition of ash falling from later eruptions or on different areas will not be identical in composition with that reported above. However, subsequent ash analyses will bear considerable resemblance, containing the same metal ions.

From a processing standpoint, it would appear that the concentrations of both iron and aluminum in a range between 4 and 18 per cent offer most cause for concern. The high iron content will be the largest problem in that it reacts with anthocyanins and tannins to produce brown or blue grey color, which reduces the quality. The high aluminum content of 18 per cent, if in soluble form, may also offer problems with regard to color changes. Dealing with iron and aluminum may be somewhat similar in that the two metal ions can be chemically treated in a similar fashion.

Initially, a washing procedure must be used to remove as much of the particulate matter and soluble metals as possible. Part of the difficulty in washing the material off of soft fruits is the fact that it is so fine (seventy-five per cent of the analysed samples, as mentioned previously, measured less than 50 microns). These small particles can readily embed in the fruit, causing color problems when the metals are solubilized. However, before any treatment can be considered to overcome metal-caused color probles, the majority of the ash must be removed by extensive washing.

The results of limited studies conducted here indicate that the best washing techniques involve agitation of the fruit in a circular direction in a tank fitted with a creen to prevent settling of the fruit to the bottom, yet allowing the ash to settle.

A water pressure through the nozzles of approximately 10 psi seemed to achieve the desired velocity and yet reduce the amount of breakage of the berries. Such a device could be fabricated in the form of a spiral that would allow a residence time of approximately 3 minutes, found in our pilot plant to be adequate for the removal of most of the ash particles from both raspberries and strawberries. Using this method, ash was removed quite effectively, but not completely, with fresh water and no additives.

Anionic food-grade detergents have been used for direct contact with fruit and offer a method of cleaning moist fruit surfaces. Substances presently cleared for use in the washing of fruits and vegetables (not to be used in excess of 0.2 per cent in wash water) are: (1) Sodium alkyl sulfonates, of which several are available, and (2) Sodium dodecyl benzene sulfonates, (a number of different surfactants with this same general structure exist differing mainly in the number of carbons in the alkyl chain). Also used for fruit and vegetable washing are sodium 2-ethyl-hexyl sulfate and sodium mono and dimethyl naphthalene sulfonates. For additional information regarding detergents, contact National Food Processors Association, 1950, 6th street Berkeley, CA. 94710, Phone 415-843-9762 regarding detergents used in washing mechanically harvested tomatoes.

A determination regarding the need for detergents should be based on an observation of the effectiveness of turbulent flow in fresh water for a measured period of time. The studies at OSU appeared to remove the ash effectively from both strawberries and raspberries without significant erosion damage to the fruit. However, the use of such an extended period of time in production washing equipment may be difficult, and therefore use of detergents along with agitation may be desirable. The use of agitation and detergent can cause excessive foaming and perhaps erosion problems. Any use of detergent must be balanced with the undesirable properties of foaming and the required removal of the detergent from the berries after washing is completed.

Regardless of washing procedure(s), steps should be taken to protect the fruit from solubilized iron and possibly aluminum from the ash. Chelating agents such as E.D.T.A., sodium hexametaphosphate or citric acid may be tried, singly or in combination. Both materials may cause some softening of the fruit and they must be used with caution. Citric acid can be effective not only for reducing pH but also as a chelater in itself, and this might be an effective way of treating fruit to prevent both a bluing effect of the anthocyanins and to remove part of the iron and other metal contaminants. Ash free, normal strawberries develop and maintain a deeper and better color at pH 3.5 and below. Therefore, lowering the pH with citric acid may have a two-fold effect with ash contaminated fruits by improving the initial color of the fruits and by removing solubilized iron and other metals.

Use of chelating agents will not be effective if adequate washing is not accomplished first, since it is not possible to add huge amounts of chelating agents to remove very heavy metal contamination, without producing adverse flavor effects in the food.

Iron oxide contained in the ash can be solubilized readily by fruit acids, within a few hours. Fruits such as cherries and berries contain anthocyanins and tannins in the cellular structure, which has relatively low pH. The presence of iron oxide over extended periods of time, during either frozen or canned storage, can cause a bluing effect on the red anthocyanin - tannin pigments, thus causing a reduction in quality. The reaction of iron with anthocyanins takes place over a period of time at the low pH of the fruit and may produce a darker color. No evaluation of the effect of residual ash on the color of the fruit during extended storage could be made in our limited washing studies.

While no extensive experimentation has been done regarding removal of the ash impregnated metals or minimizing effect on fruit quality, anything that can be done to remove or sequester free metallic ions and/or reduce the pH to minimize the effect of metallic ions on color changes which occur in anthocyanin and tannin pigments is of considerable importance.

Prior to the advent of modern pesticides (before mid-1940's) lead arsenate and Bordeau mixture (a copper fungicide) were used almost exclusively on fruits and vegetables, and posed a considerable removal problem. Fruits and vegetables were washed (dipped) in a holding tank of 0.5 to 1.5 per cent hydrochloric acid to solubilize the metals from the fruit surface, and were then extensively washed with fresh water to remove solubilized metal and acid. This technique nodoubt could be employed with some degree of success in removing metal ions coming from volcanic ash contaminants, making the acid treatment of the fruit a desirable step in the cleaning procedure. When employing hydrochloric acid for this purpose a pH of 2 or below should be maintained and extensive afterwashing is a must.

In the final analysis: The removal of ash from ripe fruit is something for which no one has first hand experience or can offer adequate answers. These are our thoughts regarding the removal of ash and the possible problems it could cause if allowed to remain on the product. These comments should not be taken as firm recommendations since we have not been able to conduct sufficient experimentation to provide you with proper answers. We do, however, stand ready to discuss these problems with you further and hope that we can be of assistance to you.

Arthur Badenhop, George Varseveld, and Darrell Beavers, Department of Food Science, Oregon State University.

Phone: 754-3463 or 754-3131

Extension Service, Oregon State University, Corvallis, Henry A. Wadsworth, director. This publication was produced and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Extension work is a cooperative program of Oregon State University, the U. S. Department of Agriculture, and Oregon counties. Extension invites participation in its programs and offers them equally to all people, without discrimination.