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THE COLORADO EXPERIMENT STATION

FORT COLLINS

REMOVAL OF ARSENATE OF LEAD FROM SPRAYED FRUIT

The Sections on Chemistry and Mechanical Engineering of this station have been giving considerable attention to the development of a simple, efficient and inexpensive method of removing excessive arsenical residues from apples that have been sprayed for the control of the codling moth. The Chemical Section has progressed with its work to a point where we feel warranted in presenting the method given below by Dr. W. P. Headden as a suggested means of accomplishing the desired results.

The Mechanical Engineering Section hopes to report later upon a mechanical device for handling the fruit in large quantities.

C. P. GILLETTE,
Director

It is now about a year since the British Board of Health made a ruling that fruit carrying more than 1-100 of a grain of arsenious oxid per pound should not be offered for sale in that country, or should be condemned as unfit for consumption. Our pure food and drug authorities have adopted the same standard, so that it becomes a question how to remove the spray materials applied to apples and pears so as to meet this requirement.

Hand and Machine Wiping have been tried, but the results have not been wholly satisfactory, even when the labor was not too expensive. Hand and also machine-wiped fruit that had been thoroly treated was sent to this laboratory for analysis, and was found still contaminated by spray materials far beyond the limit of 1-100 of a grain per pound.

There seems to be no evading the necessity of some wet method of removing the residual spray. The fruit growers apply "spreaders" to prevent the arsenate of lead from being washed off by rains and also to distribute it, thus making it more difficult to remove the arsenic.

The Oregon Station has given, in Circular of Information 11, a method based on the use of a one percent hydrochloric acid solution. It is said that good results are obtained with this solution.

The requirements of a good washing process are evident: It must be effective; it cannot consume too much time; it must not injure the fruit; it must be inexpensive in material as well as in time.

I called attention in 1908* to the fact that common table salt

*Colorado Experiment Station Bulletin 131

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(sodic chlorid) effects the decomposition of lead arsenate and Dr. C. C. McDonell, of the United States Department of Agriculture, subsequently showed the nature of the reaction. Arsenic is dissolved by a salt solution. It is also known that common soda will decompose lead arsenate and will remove oils and dissolve some albumins.

These two salts were tried in conjunction to bring about the decomposition of the arsenate of lead even in the presence of an oil and a spreader.

The solution described below meets all of the requirements demanded of a bath for removing from fruit the lead arsenate that has been used as a spray in combating the codling moth; it is cheap, quick-acting, effective, and, as yet, we have seen no bad effects upon the fruit, but no storage experiments have been made.

The solution is made by taking **four pounds each of soda ash—** (Na_2CO_3) which is washing soda that has been treated to expel all the water, and **ordinary table salt,** (NaCl) and dissolving them in 100 pounds of water. This means eight pounds of the mixture of salt and soda ash in 12½ gallons of water, or, if the reader wishes to think in larger terms, 160 pounds of the mixture to one ton of water.

This solution can be used in wooden or iron vessels and should be heated to 100° Fahr. (2 or 3 degrees more or less would make no difference), but the temperature should not, so far as my observations go, be raised materially above 100° Fahr. At 122° Fahr. the apples gave off a strong odor of apple, and, on paring, were found to be less firm than they should have been. This statement is made as precautionary and not as an established fact that the fruit was really injured.

I tried weaker solutions than the one mentioned, but the results were not satisfactory, principally because they were not uniform. This may have been due as much to the varying amounts of spreader, or even of the arsenate on the different samples treated, as to the weakness of the solution. This does not matter; the solution was too weak to give uniform and satisfactory results.

The proportions given, 160 pounds of the mixed salts to a ton of water, or 8 pounds to 100 pounds of water, may be used as follows:

To the solution in any suitable container, heated to 100° Fahr., add apples enough to cover the surface thickly and stir gently with a mop or some equivalent instrument, care being taken not to bruise the apples. The stirring should be continued for ten minutes. This stirring has two purposes; it creates a gentle friction and prevents the apples from floating with the stem cups out of the solution. In no case should the time for washing be cut to less than 5 minutes, and then only when no spreader or oil has been used upon the fruit. On removal from the bath, the apples should be rinsed to remove the wash liquid. This completes the process.

Results.—The results obtained were, in every way, satisfactory. A box of Winesaps was sent to me by Mr. Otto M. Forry, of Grand Junction, Colorado, who is responsible for the statements that the or-

chard from which they came was in good condition and the trees healthy, and that the apples received one calyx spray and eight cover sprays, using five pounds of lead to the tank. With the first three sprayings, one pound of spreader was used per tank, and with the remaining five sprayings two pounds were used to three tanks. These apples were treated as described above and we obtained from them only 0.005 grain of arsenious acid per pound of fruit, or one-half the official limit of 0.01 grain.

Another lot from Mr. Forry was a box of Black Twigs sprayed four times with lead arsenate plus a spreader, and three times with Volck oil. This lot was treated for ten minutes at 100° Fahr. and the arsenious acid remaining was less than 0.001 grain per pound. Hence, a longer treatment than ten minutes seems wholly unnecessary. The brand of lead arsenate used will make no difference. The stem and calyx cups were included in the samples analyzed, as were also the stems of the apples.

We have not had experience enough to justify a statement as to how many boxes of apples 100 gallons of this solution would effectively wash. Theoretically, four pounds of soda ash alone would dissolve the arsenious acid contained on several thousand boxes of apples. Assuming that the apples carry 0.05 of a grain of arsenious oxid per pound, one hundred gallons of solution ought to wash at least 1,000 boxes of apples.

The four pounds each of salt and soda ash purchased in quantity should not cost more than a total of 25 cents.

This method has been tested out thoroly, and will give good results if carried out as described above.

It seems unnecessary to state that small portions of the solution should be added from time to time to replace that which is gradually lost, and that the solution as it becomes dirty should be replaced by a clean one.

No attempt should be made to reduce the time of treatment by either increasing the temperature of the bath or the strength of the solution.

Attention is again called to the fact that the temperature of 100° Fahr. should not be exceeded by more than three or four degrees.

We tried a solution of double the above-mentioned strength. It seemed to do no harm, but the results did not justify its use.

We tried dipping the apples in a cheesecloth bag, but the results were not satisfactory.

For the treatment of a small crop, the grower can devise some apparatus of his own. A large kettle used for cooking stock feed might be used. A metal watering tank placed on the ground and over a trench big enough to serve as a flue for heating the solution would treat a larger crop. A hand force-pump could be used for keeping the solution circulating and spraying the fruit, so that it would be

kept in rather rapid motion for the ten minutes that it is in the bath. This is suggested to take the place of stirring wth a mop or other device. A special apparatus would be necessary only in handling large quantities of apples.

There are two things that make washing more difficult than it otherwise would be. The first one is the use of spreaders and the use of oil. The second difficulty is to get the spray residues out of deep and narrow stem cups. This method overcomes both of these difficulties.

The fruit is decidedly improved in appearance by this treatment. The natural wax is not removed.

No experiments have been made with pears because we have none at our command.

By WM. P. HEADDEN