Pesticide Residue Distribution in Strawberries

A methodological approach

BY **UDO LAMPE, JUAN HAMDI, ABRAHAM WELDAY, SEBASTIAN BIHL, J.-PETER KRAUSE, PHD**

Strawberries' popularity partly can be attributed their high levels of healthy substances, such as dietary fiber and polyphenols. However, strawberries are among the most challenging horticultural crops to grow. Growers must manage the multitude and complexity of pest issues. Chemical plant protection agents, particularly against insect, mite, and disease control, have been a critical component in maintaining crop yield and quality standards.

In order to protect consumers from the adverse effects of residues, maximum residue levels (MRL) have been established by the European Commission. The MRLs represent the highest expected residue concentration if a pesticide is applied according to good agricultural practice. Thus, products that comply with the MRLs are considered by the authorities to be safe and legally marketable.

Alongside public regulations, there has been a development of private standards by major food retail groups. Those specifications are in some cases drastically lower (in some cases 1/3 or lower) than the official MRLs or other parameters like Acute Reference Dose.

In a routine control analysis, laboratories therefore have to perform an analysis of the fruit to evaluate the legal marketability regarding MRLs. EU regulation No 752/2014 stipulates that for berries and small fruits, the MRL is applied to the whole product after removal of caps, crown, and stems (except currants). In the case of strawberries, the crown leaves have to be removed. However, no data has been found in literature about the residue distribution between fruit and leaves and, hence, about the influence of processed leaves on the residue concentration of the edible part. No indication exists to what extent the crown has to be removed by generous cutting or precise removal.

The aim of a recent study was to investigate the pesticide residue distribution between leaf and fruit to assess the risk if the crown is not completely removed.

Material and Methods

Strawberries (500 gram boxes) were purchased from local supermarkets, processed, and analyzed according to the multi-residue method for determining pesticide residues. In contrast to the routine method that separates the crown leaves

Figure 1. The crown leaves (green part) were completely removed without any further parts of the fruit.

Figure 2. The edible part of the fruit was homogenized with a mixer.

together with a small part of the fruit, in this study only the crown leaves (green part) were completely removed without any further parts of the fruit, see Figure 1.

The edible part of the fruits was homogenized with a mixer (Mycook 1.8, Taurus Professional). The green part was filled into a bottle of a cryogenic grinder (CryoMill, Retsch). The bottle was cooled down to about -30 degrees Celsius (Cool Shock Froster SF 51, Nordcap) and the frozen green part was subsequently milled without further cooling for 3 minutes, see Figure 2. After that, the pesticides were removed by solvent extraction according to QUEchERs. The determination of pesticides was carried out by gas chromatography combined with tandem mass spectrometry (Agilent, Germany). The fruit pulp was treated in the same way. The pesticide residue concentration was calculated to milligram pesticide in relation to kilogram fresh weight of the product (mg/kg).

Results and Discussion

A total amount of 30 boxes of strawberries were prepared for the investigation. The method of removing only the crown leaves led to an average of weight ratio of 0.012 between leaves and fruits, see Figure 3.

The ratio of the pesticide residue concentration between leaf and fruit strongly varied between 6 and 277. This variation was expected due to the unspecific choice of the samples, which may differ in treatments, fruit growing, storage, etc., and effects the ratio. Moreover, for 52 percent of all samples, residues were only measured in the leaves but not in the fruits. Typical residues for strawberries could be often detected and used for an evaluation of the distribution, see Figure 4. The more findings of a pesticide, the higher the variation of the factor. Since the statistical requirements are not satisfied, it is not possible to calculate an average distribution factor. But the results clearly show that the concentration of the residues at leaves is much higher than in the fruits.

What happens if a small portion of the crown is analyzed together with the fruit? The highest factor calculated was 277. If the whole strawberry is homogenized, the residue concentration will increase by a factor of 4.2. Only 10 percent of the crown would increase the concentration by a factor of 1.3, which can be critical for pesticides with a low MRL and might cause a false positive result.

The crown leaves of strawberries should be generously removed from the fruit by a clear cut below the crown to guarantee that it is removed completely. The same should be done by the consumers to avoid unnecessary intake of residues. ■

Lampe is geo-ecologist/managing director at Analytica Alimentaria GmbH. Reach him at udo.lampe@analytica.international. **Hambi** and **Welday** are laboratory technicians. **Bihl** is a food chemist. **Dr. Krause** is a physicist for Analytica Alimentaria. Reach him at peter.krause@analytica.international.

Figure 3. The method of removing only the crown leaves led to an average of weight ratio of 0.012 between leaves and fruits.

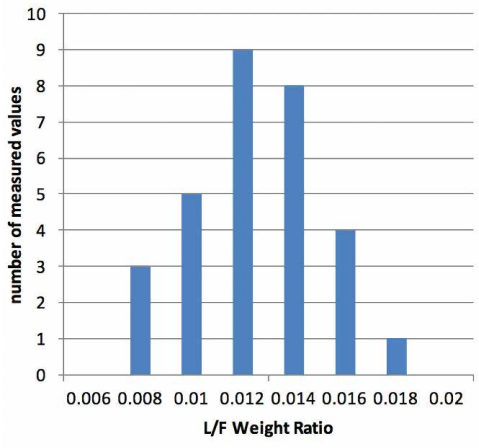

Figure 4. Typical residues for strawberries could be often detected and used for an evaluation of the distribution.