# THE EFFECT OF FARMING TYPE ON MICROBIAL SPECIES RICHNESS ON RASPBERRIES AND APPLES

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## ABSTRACT

My partner and I studied the microbial species richness on the surface of organically-farmed and conventionally-farmed fruits. We hypothesized that the organic apples and raspberries would have a higher species richness than the conventional fruits of the same kind, and that the raspberries would have an overall higher microbial species richness compared to the apples. Sterile swabs were used to plate samples taken from the raspberries and apples, and the mean total microbial species richness was compared. The results show that the only statistically significant differences in species richness came from comparing the conventional apples to the organic apples, the conventional apples and conventional raspberries, and the organic apples to the organic raspberries. All other differences found were not statistically significant. This means that even though the fruits were grown under different conditions that emphasized different aspects of production, in regards to health, there is no significant difference between the amount of fungal and bacterial species between the conventional and organic raspberries as well as between organic species of both fruits.

## INTRODUCTION

There are many differences between conventional and organic farming, and both types have their own advantages and disadvantages since each type places an emphasis on different aspects of production. Some of the main differences between conventional farming and organic farming include conventional farming generally has a higher yield than organic farming since it uses a larger land area, but organic farming has a smaller environmental impact since it uses less pesticides and herbicides (Gasser and Berg, 2011).

As well as there being differences in the production focus, there are also significant differences between the soils used in both types of farming practices. Soil from organic farms have higher bacterial species richness than soil from conventional farms (Bo et al. 2005), and the microbial profile of each type of soil shows significant differences in areas like evenness and dispersion of the microbial species (Hartmann et al. 2015). This could very well be from the fact that less pesticides are used in organic farming, making it easier for different microbes to flourish under the organic conditions than the conventional farming conditions.

There is also evidence that there is a difference in microbial species richness between organically-grown and conventionally-grown edible flowers (Wetzel et al. 2010) as well as in organically- and conventionally-grown citrus agriculture (Franca et al. 2007), which leads to our hypothesis that tests the same thing, only with fruits instead of flowers.

The purpose of our study is to determine if there is a statistically significant difference in microbial species richness between organically-farmed raspberries and conventionally-farmed raspberries as well as organically-farmed honeycrisp apples and conventionally-farmed honeycrisp apples, and to also see if there is a significant difference between the like-types of raspberries and honeycrisp apples.

My hypothesis was that the organically-farmed fruits will have a higher microbial species richness than their conventionally-farmed counterparts since the soil that they're grown in has a higher microbial species richness, which could possibly transfer onto the surface of the fruits. My other hypothesis was that in comparing the raspberries and the honeycrisp apples to one another, both types of raspberries will have a higher microbial species richness than the honeycrisp apples of the same type because the raspberries have indentations and little hairs that increase the surface area that microbes can inhabit, whereas the surface of the apples is smooth and flat, so there might be less microbial diversity on honeycrisp apples than on raspberries.

## MATERIALS AND METHODS

We obtained six organic apples, six conventional apples, six organic raspberries, and six conventional raspberries. We did not wash them prior to swabbing their surfaces. We used deionized water on sterile cotton swabs to take the samples. To take the samples, we took the twelve wet cotton swabs and swabbed a square centimeter on the surface of each of the twelve raspberries. We then spread each of the swabs onto twelve separate plates with nutrient medium, going back and forth across the surface of the medium, then turning the plate 90 degrees and going back and forth across the plate again. We used the same sampling and plating procedure for the apples, but the area of the sample taken was a square inch instead of a square centimeter. The plates were left to incubate at room temperature for a week, and the data was taken at the end of the week. To analyze the data, we used a two-sample, unpaired t-test to compare the species richness between the types of apples and types of raspberries, as well as comparing similarly-grown apples and raspberries.

## RESULTS

Data taken from six organically-farmed apples and six conventionally-farmed apples (Fig. 1) show that the mean microbial species richness was higher in the organically-farmed apples than in the conventionally-farmed apples, and the p-value was less than 0.05 (Table 1).

Data taken from six organic raspberries and six conventionally-farmed raspberries (Fig. 1) show that the difference in the mean microbial species richness of the samples is not statistically significant, with the p-value being greater than 0.05 (Table 2).

The data from the conventionally-farmed apples and the conventionally-farmed raspberries (Fig. 1) show that the mean microbial species richness was higher in the conventional raspberries. The difference is statistically significant, with the p-value being less than 0.05 (Table 3).

The data from the organic apples and the organic raspberries (Fig. 1) show that the mean microbial species richness was higher in the organic apples. The difference between the means is statistically significant, with the p-value being less than 0.05 (Table 4).

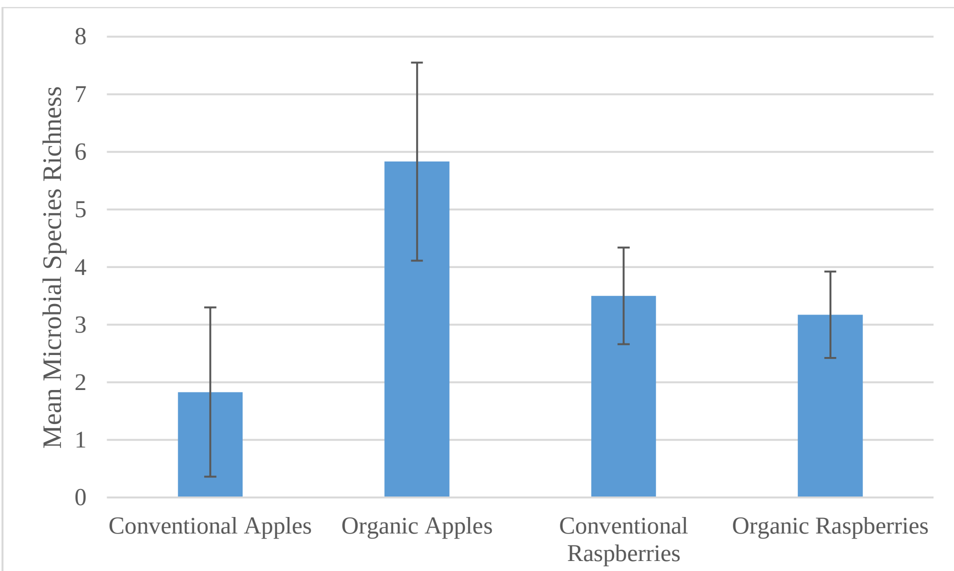


**Figure 1.** Mean microbial species richness in conventionally- and organically-farmed apples and conventionally- and organically-farmed raspberries.

**Table 1.** Total mean microbial species richness in conventional and organic apples.

| | Conventional Apples | Organic Apples |
|---|---|---|
| Mean Microbial Species Richness | 1.83±1.47 | 5.83±1.72 |

P-Value=0.002

**Table 2.** Total mean microbial species richness in conventional and organic raspberries.

| | Conventional Raspberries | Organic Raspberries |
|---|---|---|
| Mean Microbial Species Richness | 3.5±0.84 | 3.17±0.75 |

P-Value=0.75

**Table 3.** Total mean microbial species richness in conventional apples and conventional raspberries.

| | Conventional Apples | Conventional Raspberries |
|---|---|---|
| Mean Microbial Species Richness | 1.83±1.47 | 3.5±0.84 |

P-Value=0.0366

**Table 4.** Total mean microbial species richness in organic apples and organic raspberries.

| | Organic Apples | Organic Raspberries |
|---|---|---|
| Mean Microbial Species Richness | 5.83±1.72 | 3.17±0.75 |

P-Value=0.0060

## DISCUSSION

Our hypothesis that the organically-farmed fruits will have a higher microbial species richness than the same conventionally-farmed fruits was rejected. The hypothesis was supported by the apples, but not the raspberries. The mean for the organic apples was higher than the mean for the conventional apples, and the p-value was less than 0.05, suggesting that the results are statistically significant. The raspberries were different in that the mean total microbial species richness of the conventional raspberries was higher than the organic raspberries, rejecting our hypothesis.

Our hypothesis that the conventional and organic raspberries will have a higher microbial species richness than the apples of the same type was also rejected. The hypothesis was supported by the data from the conventionally-grown fruits, but rejected by the data from the organically-grown fruits. The p-value comparing the species richness between conventional apples and raspberries was 0.02, which shows that the conventional raspberries had significantly higher species richness than the conventional apples. The organic fruits showed different results since the mean for the apples was higher than the mean for the raspberries, rejecting the hypothesis.

One possible reason for the microbial species richness of the different types of raspberries being so similar is that the fungi species from the raspberries were excluding the bacterial species on the surface of the raspberry. The fungi on the plates that we had took up the entire surface of the medium and extended to reach the top of the plate. They were taking up so much space that it's possible that they were competitively excluding the bacteria from growing on the plate.

The results of this show that the differences in the focus of production in each type of agriculture does not necessarily result in a difference in surface microbial species richness on apples and raspberries. It also shows that while the organic soil type has a higher species richness than the conventional soil type (Bo et al. 2005), that difference in microbial species richness does not necessarily mean that those same differences will show up on the surfaces of the fruits produced in each condition.

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