Ropa Science Research

# Comparison of Mineral and Enzyme Levels in Raw and Processed Honey

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# Introduction

Visit any farmer's market or holistic grocery store and chances are, consumers will have the opinion that honey that is "raw", "unfiltered" or "unprocessed" is "healthier." Although consumers rarely have a precise understanding of those terms or can explain why honey's properties may change after heating and filtration, the issue is one that the honey industry needs to fully understand.

To ascertain just how much honey changes after it has been heated and filtered, the National Honey Board contracted with American Analytical Chemistry Laboratories to test honey samples taken prior to processing and then after being processed. The goal was to find out the degree to which the minerals, antioxidants and enzymes change after honey is sent through an industrial processing system.

# Methodology

Two industrial honey packers were contacted to provide samples. Suppliers are referred to as "Supplier #1" and "Supplier #2". Each supplier provided four samples of honey that had not yet been processed and another final sample of blended honey that had gone through the heating and filtering process.

Supplier #1's honey was kept in the drum and subjected to three days in a tempering room. The air temperature was about 130 degrees F. The honey was then removed from the drums, flash heated to 185 F for 5 minutes, and filtered with DE to remove particles larger than 16 microns. Then immediately cooled to about 140 F, pumped into a holding tank, from which it is packaged.

Supplier #2 prepared its honey by heating it in a melting tank to 140 ºF for 15 hours. It was then transferred to a settling tank for 8 hours at a temperature of 125 ºF. The honey was filtering with DE at 175 ºF for 5 minutes and then placed in a hold tank for 24 hours at 130 ºF.

Supplier #2 also provided four honey samples that went through a "strained" filtration system which utilizes less heat and a larger pore size filter. The strained honey sample were subjected to the same temperatures. Results for the strained honey samples are also included in the data section.

Due to the nature of industrial honey processing, it was not possible to test the exact same sample of honey both pre- and post-processing. Honey suppliers blend multiple

samples of honey into one batch, and therefore, the testing of four single samples and one final sample was utilized.

## Measures

AAC Labs conducted the following tests on the honey samples they received:

Enzymes
1. Phosphatase
2. Amylase
3. Glucose Oxidase
4. Invertase
5. Catalase

Minerals
6. Calcium
7. Magnesium
8. Phosphorus
9. Potassium

Antioxidants
10. ORAC
11. Polyphenols

## Data

**Supplier #1 Samples - November 2, 2010**

| Parameter | Preprocessing Samples: Sample 1-1 DE | Sample 1-2 DE | Sample 1-3 DE | Sample 1-4 DE | Pre-process Avg. | Supplier #1 Blend DE | Percent Change | Units |
|---|---|---|---|---|---|---|---|---|
| Phosphatase | 226.7 | 195.5 | 261.2 | 213.1 | 224.13 | 208 | -7.19% | HFU/g |
| Amylase | 11.57 | 6.2 | 3.46 | 4.08 | 6.33 | 2.14 | -66.18% | DU/g |
| Glucose Oxidase | 5.96 | 5.24 | 9.66 | 5.02 | 6.47 | 2.59 | -59.97% | GOT Units/g |
| Invertase | 33.4 | 88.8 | 15.9 | 28.4 | 41.63 | 0.5 | -98.80% | SU/g |
| Catalase | 0.43 | 0.36 | 0.47 | 1.15 | 0.60 | 0.38 | -36.93% | Baker's Units/g |
| AVERAGE CHANGE in ENZYMES | | | | | | | **-53.81%** | |
| Calcium | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00% | mg/serving |
| Magnesium | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00% | mg/serving |
| Phosphorus | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00% | mg/serving |
| Potassium | 0.031 | 0.0279 | 0.0289 | 0.01 | 0.02 | 0.0354 | 44.79% | mg/serving |
| AVERAGE CHANGE in MINERALS | | | | | | | **11.20%** | |
| ORAC | 0.843 | 0.779 | 0.665 | 0.546 | 0.71 | 0.724 | 2.22% | U/g |
| Polyphenols | 1 | 1 | 1 | 1 | 1.00 | 1 | 0.00% | % |
| AVERAGE CHANGE IN ANTIOXIDANTS | | | | | | | **1.11%** | |

## Supplier #2 DE Samples - November 2, 2010

| Parameter | Preprocessing Samples | | | | | Supplier #2 Blend DE | Percent Change | Units |
|---|---|---|---|---|---|---|---|---|
| | Sample 2-1 DE | Sample 2-2 DE | Sample 2-3 DE | Sample 2-4 DE | Pre-process Avg. | | | |
| Phosphatase | 235.1 | 200.1 | 180.7 | 246.1 | 215.50 | 184.7 | -14.29% | HFU/g |
| Amylase | 6.47 | 12.36 | 5.35 | 8.92 | 8.28 | 10.35 | 25.08% | DU/g |
| Glucose Oxidase | 7.89 | 4.9 | 9.8 | 5.51 | 7.03 | 4.73 | -32.67% | GOT Units/g |
| Invertase | 15.9 | 6.7 | 10.5 | 14.9 | 12.00 | 8.6 | -28.33% | SU/g |
| Catalase | 0.8 | 1.18 | 0.76 | 0.83 | 0.89 | 0.69 | -22.69% | Baker's Units/g |
| AVERAGE CHANGE in ENZYMES | | | | | | | **-14.58%** | |
| Calcium | 0.26 | 0.24 | 1.17 | 0.37 | 0.51 | 0.28 | -45.10% | mg/serving |
| Magnesium | 0.07 | 0.03 | 0.12 | 0.05 | 0.07 | 0.14 | 107.41% | mg/serving |
| Phosphorus | 1.67 | 0.51 | 0.76 | 0.73 | 0.92 | 0.65 | -29.16% | mg/serving |
| Potassium | 0.15 | 0.12 | 0.15 | 0.73 | 0.29 | 0.21 | -26.96% | mg/serving |
| AVERAGE CHANGE in MINERALS | | | | | | | **1.55%** | |
| ORAC | 0.689 | 0.561 | 0.658 | 0.592 | 0.63 | 0.808 | 29.28% | U/g |
| Polyphenols | 0.4 | 0.3 | 0.34 | 0.35 | 0.35 | 0.42 | 20.86% | mg/serving |
| AVERAGE CHANGE IN ANTIOXIDANTS | | | | | | | **25.07%** | |

## Supplier #2 "Strained" Samples - November 2, 2010

| Parameter | Preprocessing Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sample 2-5 (strain) | Sample 2-6 (strain) | Sample 2-7 (strain) | Sample 2-8 (strain) | Pre-process Avg. | Supplier #2 Strained Blend | Percent Change | Units |
| Phosphatase | 208.5 | 150.7 | 185.4 | 181.53 | 181.53 | 151.1 | -16.76% | HFU/g |
| Amylase | 73.42 | 22.81 | 8.12 | 34.78 | 34.78 | 9.91 | -71.51% | DU/g |
| Glucose Oxidase | 11.61 | 12.52 | 2.58 | 8.90 | 8.90 | 17.86 | 100.60% | GOT Units/g |
| Invertase | 0.5 | 5.8 | 10.4 | 5.57 | 5.57 | 0.5 | -91.02% | SU/g |
| Catalase | 0.57 | 0.59 | 1.09 | 0.75 | 0.75 | 0.79 | 5.33% | Baker's Units/g |
| AVERAGE CHANGE in ENZYMES | | | | | | | **-14.67%** | |
| Calcium | 0.32 | 0.41 | 0.42 | 0.38 | 0.38 | 0.36 | -6.09% | mg/serving |
| Magnesium | 0.09 | 0.08 | 0.09 | 0.09 | 0.09 | 0.09 | 3.85% | mg/serving |
| Phosphorus | 1.89 | 0.85 | 1.01 | 1.25 | 1.25 | 0.84 | -32.80% | mg/serving |
| Potassium | 0.17 | 0.24 | 0.59 | 0.33 | 0.33 | 0.33 | -1.00% | mg/serving |
| AVERAGE CHANGE in MINERALS | | | | | | | **-9.01%** | |
| ORAC | 2.35 | 2 | 2.28 | 2.21 | 2.21 | 2.6 | 17.65% | U/g |
| Polyphenols | 1.1 | 1.13 | 1.06 | 1.10 | 1.10 | 1.1 | 0.30% | mg/serving |
| AVERAGE CHANGE IN ANTIOXIDANTS | | | | | | | **8.98%** | |

# Conclusion

This research shows a great deal of variability between samples from the same supplier as well as samples across suppliers. Because of this level of variation, it is difficult to draw more than general conclusions regarding the changes that occur to honey post-processing. However, processing is not a fully destructive process, as some consumers would have others believe. Heating and filtering honey does not completely eliminate all enzymes, nor does it have a negative effect on honey's mineral and antioxidant levels.

## Enzymes

Without a doubt, heating and filtering honey reduces the final quantity of enzymes in honey. Enzyme levels dropped an average of about 35% when heating and DE filtration was used. Enzyme levels dropped about 15% using heating and straining. Enzymes such as invertase were nearly completely eliminated by processing (average drop of 73%). Others, such as phosphatase dropped about 13%.

That there was an average reduction is not a complete surprise—most enzymes are destroyed by heat. However, honey's enzymes were not completely destroyed by processing. Quite the contrary, some enzymes increased after being blended. It is likely this occurred due to the highly variable nature of the honey samples. For instance, the range in enzyme levels for some honeys were two the three times higher from one sample to the next.

## Minerals

Minerals are inorganic elements that come from the earth; soil and water and are absorbed by plants. Animals and humans absorb minerals from the foods they eat. Vitamins and minerals are nutrients that the body needs to grow and develop normally.

For the most common minerals found in honey, there was actually a net increase of about 1% in calcium, magnesium, phosphorus and potassium. Minerals are typically resistant to heat, and therefore, processing does not cause a negative impact on the mineral content of honey. Although these quantities are typically quite low, these elements are still important for human function and are not found in most other sweeteners.

## Antioxidants

In all three cases, the average percentage of antioxidants found in the end product increased, rather than decreased, with processing. AAC Labs looked at the oxygen radical absorbance capacity (ORAC) of the honey, which is a method of measuring the antioxidant capacity of different foods and supplements. It was developed by scientists at the National Institutes of Health. It is believed that foods higher on the ORAC scale will more effectively neutralize free radicals. This will slow free radical damage in the body that can contribute to

age-related degeneration and disease. On average, the antioxidant levels based on the study determined that ORAC values actually increased about 16.4%.

## Follow-Up

Given the costs of conducting a test of this nature (there were 11 tests conducted on 15 different samples of honey for a total of 155 data measures) it is unlikely that this analysis will be repeated. Furthermore, honey's variability makes it quite difficult to draw significant conclusions.

However, this information may help balance the rhetoric of individuals who may set raw honey far apart from filtered honey. Although honey experiences significant reductions in some enzyme levels, it is not always the case for all enzymes. Furthermore, in some cases, levels of minerals and antioxidants increased, likely due to the effects of averaging the samples after processing.

A more balanced approach to the promotion of honey as a healthy, unique ingredient is warranted by this study. These data do not tilt the balance in one way or another. Neither raw nor processed honey is superior to the other in every way.

That said, for some product applications, where enzyme levels are a concern, heating and filtration are a necessity rather than a hindrance. In other situations, where high levels of the enzyme glucose oxidase may be needed, raw honey provides a significant advantage.