Ropa Science Research

Comparison of Vitamin, Mineral and Antioxidant Levels in Raw and Processed Honey

Introduction

Honey, by definition, is the substance made when the nectar and sweet deposits from plants are gathered, modified and stored in the honeycomb by honey bees. When bees undergo this miraculous collection, pollen can get transferred into the honey. However, honey is not produced from pollen, it is produced by the use of nectar. Because the levels of pollen vary so greatly from one honey sample to the next, pollen levels are not a valid indicator of honey quality.

As an industry, it has become necessary to address just what happens to honey after it has been removed from the hive, blended and filtered. Some non-honey industry users have claimed, rather boldly, that honey without pollen is "no longer honey."

In addition, through the results of a consumer attitude and usage study conducted by the National Honey Board in 2012, researchers determined that 82% of the respondents felt that "there is more nutritional value in raw honey than processed honey." Due to these consumer perceptions, the National Honey Board determined it was necessary to find out if there are, in fact, any nutritional differences between raw and processed honey.

By looking at what happens to honey when it is prepared for retail markets, the industry can better understand how honey is changed by heating and filtration. The following study followed samples of honey from removal from the hive to their preparation for retail sale.

Methodology

In the summer of 2012, 22, 55-gallon drums of canola honey were received from Canada by a large honey supplier. The batch of honey weighed approximately 14,300 pounds. Upon arrival, five drums of the honey were independently sampled. These samples were labeled "Raw Samples 1-5."

All 22 drums were then emptied and mixed together. The honey was melted and blended at 140°F for 18 hours. This helped to homogenize the honey thereby reducing the variability between samples. Two samples were taken after blending and labeled "Blended 1 & 2."

The entire batch was allowed to settle at 130°F for 12 hours. After settling the honey was manually skimmed to remove foam and extraneous solids on the surface of the honey. It was then flash heated to 175°F for approximately seven minutes. At that point, the honey was filtered using diatomaceous earth (DE). It was flash cooled to 130°F and held for packing into containers. Two final samples were taken and labeled "Filtered Samples 1 & 2." The honey was then packaged at about 120-130°F. The honey continued to cool until it reached an ambient temperature of approximately 70°F.

Measures

After the samples were collected, they were sent first to Covance Labs (Madison, Wisc.) which conducted the following tests on the honey samples they received using the described methods.

Vitamins
- B12θ
- Folic Acid**
- Pyridoxineλ, Ω

Minerals*
- Calcium
- Magnesium
- Potassium

Antioxidants (ORAC)
- Hydrophilic***
- Lipophilic****

* *Elements by ICP Emission Spectrometry (ICP_S:13) Official Methods of Analysis of AOAC INTERNATIONAL, 18th Ed., Method 984.27 and 985.01, AOAC INTERNATIONAL, Gaithersburg, MD, USA, (2005)*

θ *Official Methods of Analysis of AOAC INTERNATIONAL, 18th Ed., Methods 952.20 and 960.46, AOAC INTERNATIONAL, Gaithersburg, MD, USA, (2005).*

** *Folic Acid (FOAN_S:13) Official Methods of Analysis of AOAC INTERNATIONAL, 18th Ed., Methods 960.46 and 992.05*

*** *ORAC (ORAC_S:4) Journal of Agricultural and Food Chemistry (2003)3272-3279.*

**** *ORAC (ORLP_S:5) Journal of Agricultural and Food Chemistry (2003)3272-3279.*

λ *Official Methods of Analysis of AOAC INTERNATIONAL, 18th Ed., Method 961.15, AOAC INTERNATIONAL, Gaithersburg, MD, USA, (2005).*

Ω *Atkins, L., Schultz, A. S., Williams, W. L., and Frey, C. N., "Yeast Microbiological Methods for Determination of Vitamins," Industrial and Engineering Chemistry, Analytical Edition, 15:141-144, (1943).*

The vitamins and minerals to be tested were selected based on the average quantities found in honey nationwide. Using honey compositional data from the National Honey Board, researchers chose to test for vitamins B12, folic acid and pyroxidine; minerals calcium, magnesium and potassium; and both the hydro- and lipophilic antioxidants. After testing for vitamins, minerals and antioxidants, the samples were sent to ABC Labs (Gainesville, Fla.) to complete the pollen analysis of all nine samples. The pollen analysis included a summary of the pollen concentration values, which are calculated in grains per 10 g.

Data (Pre-blended Samples)

Data were provided during the months of August and September, 2012. The following is a description of the vitamin, mineral, antioxidant and pollen levels in the pre-blended samples.

Pre-Blended Samples	Pre-Blended Honey Sample #1	Pre-Blended Honey Sample #2	Pre-Blended Honey Sample #3	Pre-Blended Honey Sample #4	Pre-Blended Honey Sample #5	Pre-blended Averages
Vitamins & Minerals						
Calcium (mg)	3.64	3.94	3.44	3.32	3.37	3.542
Magnesium (mg)	1.4	1.52	1.31	1.31	1.35	1.378
Potassium (mg)	13.5	15.1	11.9	11.6	10.8	12.580
Pyridoxine (mg)	0.015	0.019	0.02	0.015	0.014	0.017
Pollen (grains/10g)	76,933	57,178	53,684	123,112	61,427	74,467
B12 (µg)	<.120	<.120	<.120	<.120	<.120	<.120
Folic Acid (µg)	<6	<6	<6	<6	<6	<6
ORAC						
Hydrophilic (µmol TE/g)	1	1.14	1.22	1.11	1.22	1.138
Lipophilic (µmol TE/g)	0.168	0.195	0.199	0.185	0.188	0.187
Total	1.17	1.34	1.42	1.3	1.41	1.328

Data (Blended Samples)

The data were collected during August and September, 2012 and were taken randomly after the honey was blended.

Blended Samples	Blended Honey Sample #1	Blended Honey Sample #2	Blended Averages	Change from Pre-blended Samples
Calcium (mg)	3.44	3.5	3.47	-2.0%
Magnesium (mg)	1.33	1.33	1.33	-3.5%
Potassium (mg)	12.9	13.1	13	3.3%
Pyridoxine (mg)	0.016	0.016	0.016	-3.6%
Pollen (grains/10g)	62,651	79,076	70,864	-4.8%
B12 (µg)	<.120	<.120	<.120	0.0%
Folic Acid (µg)	<6	<6	<6	0.0%
ORAC				
Hydrophilic (µmol TE/g)	1.1	1.22	1.16	1.9%
Lipophilic (µmol TE/g)	0.208	0.234	0.221	18.2%
Total	1.31	1.45	1.38	3.9%

Data (Heated & Filtered Samples)

The data were collected during August and September, 2012 and were taken randomly after the honey was blended.

Heated & Filtered Samples	Filtered & Heated Honey Sample #1	Filtered & Heated Honey Sample #2	Filtered Averages	% Change from Pre-Blended Honey
Calcium (mg)	3.52	3.62	3.57	0.8%
Magnesium (mg)	1.5	1.5	1.5	8.9%
Potassium (mg)	13.9	14.8	14.35	14.1%
Pyridoxine (mg)	0.016	0.014	0.015	-9.6%
Pollen (grains/10g)	0	0	0	-100%
B12 (µg)	<.120	<.120	<.12	No Change
Folic Acid (µg)	<6	<6	<6	No Change
ORAC				
Hydrophilic (µmol TE/g)	1.2	1.25	1.225	7.6%
Lipophilic (µmol TE/g)	0.218	0.212	0.215	15.0%
Total	1.42	1.46	1.44	8.4%

Conclusion

The data show that processing honey did not result in the destruction of the vitamins, minerals and antioxidants analyzed. From shortly after being removed from the hive until the time the honey is heated and filtered during processing, the vitamins, minerals and antioxidants found in honey change in varied ways. For instance, calcium, magnesium and potassium all experience slight increases after processing, though the level of significance changes. On average, honey's calcium levels increase 0.8% after processing, magnesium rises 8.9% and potassium goes up 14.1%. Additionally, the hydro, lipo and total antioxidant levels in honey increase post processing. Total antioxidants increase an average of 8.4%, while hydrophilic rise 7.6% and lipophilic rise 15%. In many cases, heating and filtering honey does not have a negative effect on honey's mineral and antioxidant levels.

While the tested minerals and antioxidants showed slight increases after processing, the vitamins showed either no change or a slight decrease. Folic acid and Vitamin B12 experienced no measurable change during heating and filtration, and pyridoxine dropped 9.6%. In addition, pollen was completely eliminated after filtration.

It is important to look critically at the data in a study such as this to hypothesize as to why such changes in honey's vitamin, mineral and antioxidant levels would increase after heating and filtration. There are a few potential rationales, that are all worthy of additional discussion.

1) **Honey's variability make the use of averages unsuitable in a study of this type.**

   Given honey's wide ranges in the data collected, it is possible that using averages in the data allow outliers to distort overall changes. For instance, potassium levels in the pre-blended samples ranged from 10.8 mg to 15.1

mg, a difference of 43%. This high variability makes it difficult to draw accurate conclusions about the results of heating and filtration.

2) **The process of heating honey helps eliminate moisture, thereby increasing the concentration of vitamins, minerals and antioxidants.**

   It may be necessary to look at the average moisture content of the honey before and after processing to see if, through a loss of moisture, the vitamins and minerals in 100g of honey became concentrated, thereby creating the effect of increasing the level in the composition of the honey.

3) **Diatomaceous earth (DE) increases the concentration of vitamins, minerals and antioxidants in honey.**

   The diatoms that make up DE are composed, primarily, of silica, alumina and iron oxide. The silica, in particular, could be influencing the results of the antioxidant tests in that silica functions like an antioxidant in some applications.

Follow-Up

It is recommended that statistical analysis be conducted to calculate the significance of the amount of change in each of the measures. It is likely that some of the changes in vitamin, mineral and antioxidant levels will be insignificant statistically. This may also clarify the effects of honey's variability on overall results.

The research indicates that a balanced approach to the promotion of honey as a healthy, unique ingredient is warranted by this study. Neither raw nor processed honey is superior to the other in every way. Both filtered and unfiltered honeys provide benefits that are not found in most other sweeteners, which will continue to set honey apart from many common sweetening ingredients.