Report to the Officers and Board of Directors of the

Committee for the Promotion of Honey and Health

January 17, 2008

The First International Symposium on Honey and Human Health is now history. Attended by nearly 200 individuals – beekeepers, honey producers, honey enthusiasts, scientists, university professors and members of the media from more than 10 countries – the Symposium produced scientific research underscoring the following:

- The message of honey and health has moved from folklore and traditional medicine to 21st century practice backed by good science
- Honey producer's and honey sellers can now speak with confidence when referencing their product's health values
- Honey consumers can consume without guilt, knowing that science has confirmed what many have know intuitively for decades.

Scientists and researchers from Sweden, New Zealand, Australia, the United Kingdom, Switzerland, Israel, and the United States presented research and original presentations that covered the following categories:

- The History of Honey and Health
- New Discoveries Regarding the Microbiology of Honey
- Clinical Applications for Honey

The history of honey and health was discussed in two presentations:

- Dr. Stefan Bogdanov from Switzerland presented a paper soon to be published by the Journal of the American College of Nutrition that summarized our current knowledge regarding honey's use for nutrition and health. His review included references to 169 papers from the world's contemporary scientific literature.
- Kirsten Traynor, a returning Humboldt scholar, delivered an artistic and poetic summary of honey and health in a presentation she entitled "A Historical Romp through Legends, Lore and Astonishing Facts". Kirsten documented man's encounter with honey throughout 15,000 years of recorded history.

Two PhD microbiologists from Lund University in Sweden presented the most novel research discovery regarding honey. Their research is yet to be published. Drs. Tobias Olofsson and Alejandra Vasquez in their presentation entitled, "Lactobacillus: The Missing Link in Honey's Enigma", showed evidence from their research that different varietals of honey possess a large amount of viable lactobacilli (6 species) and bifidobacteria (4 species). They proposed that the transient presence of these bacteria and their longer lasting metabolites may explain many of the "mysterious therapeutic properties of honey". Different varietals of honey possess a large amount of these viable lactobacilli (6 species) and bifidobacteria (4 species). Tobias and Alejandra confirmed what has been suggested by other researchers that the therapeutic properties of honey are dependent upon the types of flowers from which the bees forage nectar.

One notable comment from their presentation was in regard to the care and feeding of bees themselves. Lactobacilli, bacteria that deliver protective and beneficial benefits to both bees and humans, were not found in bee's honey stomach during the winter months when the bees under investigation were fed sucrose, indicating that certain bee-feeding practices may have dangerous and unwanted affects on bees.

Clinical applications comprised the majority of the Symposium format and focused on:

- The Role of Honey in Restorative Sleep
- Honey & Insulin Resistance, Obesity and Diabetes
- Honey & Memory, Cognition and Anxiety
- Honey as an Effective Cough Suppressant
- Honey and its Role in Immune System Enhancement
- Honey as an Effective Antimicrobial

Foundational to these clinical applications was a presentation by Mike McInnes entitled "The Role of Honey in Restorative Sleep". McInnes' professional background as a pharmacist and exercise physiologist and trainer consultant has led him to re-discover principles of human metabolism that have been overlooked or ignored. His presentation emphasized the need for proper fueling of the liver as central to optimal glucose metabolism during sleep and before-, during and post-exercise.

McInnes stated that honey is the best natural food to accomplish this liver fueling due to the nearly 1:1 ratio of fructose to glucose found in honey. It is fructose that "unlocks" the enzyme from the hepatocyte nucleus that is necessary for the incorporation of glucose into glycogen in the liver. An adequate glycogen store in the liver is essential for brain fuel during the night fast and during prolonged exercise. Without sufficient glycogen, the brain triggers the release of stress hormones – adrenalin and cortisol – in order to convert muscle protein into glucose.

Repeated metabolic stress from cortisol produced in excess when there are less than optimal liver glycogen stores during sleep, leads over time, to impaired glucose metabolism, insulin resistance, diabetes and increased risk for cardiovascular disease, hypertension, obesity, osteoporosis, some forms of cancer, and several neuro-degenerative conditions. All are conditions associated with increased oxidative stress.

Not only does honey insure adequate glycogen stores in the liver, but also may play a significant role in reducing oxidative stress via the antioxidants, minerals and other bioactive principles it contains. "Honey is an intelligent food, an informed food", McInnes stated, "and must be differentiated from other sweeteners."

Following McInnes was Dr. David Baer, from the USDA Agriculture Research Service Beltsville Human Nutrition Research Center. His paper entitled, "The Challenges of Insulin Resistance – Does Honey Have a Role?" outlined the history, diagnosis and prevalence of diabetes in the United States and around the world. In summarizing two significant research studies, one from 1985 and one from 2007 comparing the plasma glucose responses to the ingestion of honey, sucrose and glucose, Dr. Baer showed graphically that the body's tolerance to honey is significantly better than to sucrose or glucose alone. Individuals with greater glucose intolerance (e.g. those with mild diabetes to Type 1 diabetes) showed significantly better tolerance to honey than to sucrose. In his summary, Dr. Baer said that "some clinical studies show improvement in glucoregulatory control with honey compared to other carbohydrate sources (most notably glucose).

From the United Press International in a story published January 8th, 3:13 PM that referenced the Symposium, Dr. Baer was quoted, "Experimental evidence indicates that consumption of honey compared to some other sweeteners may improve blood sugar control and insulin sensitivity."

Dr. Baer noted that diabetics generally have increased oxidative stress as the result of increased oxidative damage of cellular DNA, lipids, and proteins. In addition, diabetics are prone to

increased vascular damage and impaired vascular function. He stated that antioxidants may be beneficial for diabetics and help to improve endothelial function and vascular health. He concluded that the small amounts of antioxidants in honey may be beneficial in reducing oxidative stress, frequently by a larger factor than can be explained by the actual amount of measurable antioxidants found in honey.

Jessica Beiler, MPH from Penn State College of Medicine Pediatric Division in Hershey, Pennsylvania delivered a presentation summarizing the findings of a rather elegant research study funded by the National Honey Board comparing honey as a cough suppressant to dextromethorphan (DM) or no treatment in pediatric patients. Citing numerous studies which showed no significant beneficial effect of OTC cough medicines in treating children's cough due to cold symptoms, Beiler presented a strong rationale for using honey, a recommendation of the World Health Organization 2001 topic review which concluded that honey was a cheap and safe demulcent treatment for cough and cold symptoms.

The objective of the study was to compare the benefits of a single nocturnal dose of Buckwheat honey and an artificial honey flavored DM with no treatment on the nocturnal cough and sleep difficulty associated with childhood URIs. An associated outcome of interest was the effect of honey on parental sleep by its use in children.

The results were particularly startling. Children in the honey group scores improved by an average of 10.71 points compared to 8.39 for DM treatment, and 6.41 for no treatment, a statistically significant difference. Parents reported that kids slept better in the honey group with a 2.49 point improvement compared to 1.79 for the DM group and 1.57 points for no treatment, while a small % reported side effects of hyperactivity, insomnia, and nervousness, more commonly reported with honey treatment.

Beiler concluded that honey provided the greatest symptomatic relief for nocturnal cough and sleep difficulty due to URI when compared with DM or no treatment. Despite mild side effects, honey appears to be a preferable treatment for children over 1 year of age with cough and sleep difficulty due to URI.

In what was perhaps the most entertaining and clinically relevant presentation, Dr. Nicola Starkey from the University of Waikato, New Zealand, delivered the findings from a study of honey: its effects on weight gain, anxiety and memory in rats. Dr. Starkey and her study group set out to investigate the effects of sucrose, honey and a low glycemic index (GI) sugar free diet on weight gain, behaviour and biochemical measures in rats. Key findings from this year long observational study included the following:

Rats on the honey based diet showed:

- reduced weight gain & percentage body fat
- decreased anxiety
- better spatial recognition memory
- improved HDL cholesterol
- Improved blood sugar levels (HA1c)
- reduced oxidative damage

Dr. Starkey's discussion of the results on weight gain and glucose levels indicated that:

- Both sugar free (amylose) and honey- fed rats showed less weight gain and better HA1c levels than sucrose fed rats. This effect was possibly due to lower GI of honey.

- HA1c levels are also decreased by antioxidants, so these effects could be due also to the antioxidant properties of the honey.
- Reduced weight gain in honey-fed rats may also be due to the insulin mimetic effects of hydrogen peroxide produced by the honey.

Regarding the effects on cholesterol and oxidative damage, she pointed out that the

- HDL cholesterol in honey-fed rats was 15-20% higher than rats fed sugar free or sucrose diets, a finding which supports the link between high GI and low HDL cholesterol.
- Lower levels of oxidative damage in honey-fed and sugar free diet rats (5%) was possibly linked to the GI

Honey fed-rats showed reduced anxiety and improved spatial memory compared to either the sucrose-fed or sugar free-diet rats, an observation probably due to combined low GI and high antioxidant effects of honey. Dr. Starkey noted that different areas of the hippocampus mediate these behaviors in both animals and humans and this area is particularly susceptible to oxidative damage. The findings in their study were supported in studies with other antioxidants compounds.

In conclusion, Dr. Starkey stated that honey may be a healthier replacement for sucrose, particularly in those with poor glycemic control, or who are at high risk from cardiovascular disease". Honey could be used as replacement for sucrose in processed food and finally "honey may help to decrease anxiety and maintain memory functions as we age." She noted that in this rather long animal study the "positive effects of honey only occurred over the long term" (greater than 4 months) suggesting that honey's most beneficial health benefits may not be manifest for several months or years, especially in humans.

In her presentation entitled "The Grossly Underutilized Anti-microbial", Dr. Shona Blair from the University of Sydney, Australia, gave honey the challenge presented by several "problematic pathogens" including:

- Antibiotic resistant micro-organisms
- Anaerobes (60 species)
- Fungi (Candida and Tinea)
- Biofilms

Dr. Blair cited its low water activity, low pH, hydrogen peroxide generating capacity and other "floral factors" as the reasons for the antimicrobial activity of honey. Multiple varietals of honey were tested by Dr. Blair and her associates. Though there is wide variation among varietals as to their effectiveness as an antimicrobial, within the honey used in this study, effective mean concentrations of honey varied from 2 to 16% against the problematic pathogen categories listed above. Sugar solutions used as controls required mean concentrations of > 20 to 45% to achieve the same in vitro effects.

In conclusion, Dr. Blair stated that "honey dressings should be used as a 'first choice', not as a 'last resort'". Honey is effective at low concentrations against a broad spectrum of bacteria, fungi, biofilm producing, and resistant organisms but the honey varietal is critical as antimicrobial properties can be 100 X greater from one varietal to the next. Honey provides excellent prophylaxis, stimulates healing (re-epithelialization) and possesses ideal dressing properties. Honey is cost effective and "*Honey has no side effects!"*

The effect of oral honey on the immune system was described in a paper that was to have been presented by Dr. Jamal Zidon, et al, from a study conducted in several hospitals in Israel. In Dr. Zidon's absence, the moderator for the Symposium, Dr. Ron Fessenden presented salient findings from this research including:

- Honey was effective in decreasing the incidence of acute febrile neutropenia in 64% of patients
- Honey reduced the need for Colony Stimulating Factor (CSF) in 60% of patients with AFN
- Honey seemed to have a role in increasing neutrophil and decreasing thrombocytopenia
- Honey stabilized hemoglobin levels at > 11 gm/dl
- 32% of the cancer patients included in the study reported improved quality of life

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In the final presentation of the one-day symposium, Dr. Fessenden summarized future directions for honey research. The most promising categories of honey research seemed to be in the areas of:

- Restorative sleep & off-line processing
- Memory and cognitive function
- Insulin resistance & blood sugar control
- Immune system enhancement
- Anti-microbial effects

Dr. Fessenden pointed out several specific types of research needed to confirm many of the positive healthful benefits that were suggested or indicated by the research presented in the symposium. These are:

- Human observational studies (short term)
- Studies investigating mechanisms of action of honey within the human
- Clinical trials involving larger study groups
- Population or epidemiological studies*

This latter group* was characterized as expensive, fraught with many confounding variables, challenges with control cohorts, and accidental correlations. Instead, he suggested several examples of human studies that could be conducted now at minimal expense. These included:

- Sleep lab studies observing REM sleep / measuring cognitive abilities post-honey dosing vs. no pre-bedtime or other food ingestion
- Expansion of oral honey "tolerance" tests measuring effects on blood glucose, HA1c, triglycerides, HDL cholesterol, and insulin response compared to glucose, HFCS, artificial sweeteners
- Additional clinical trials using honey in pre-diabetic and diabetic patients
- Studies focused on the mechanisms of action for honey in immune system enhancement

From these types of study results, the scientific and medical community should be able to deduce longer term consequences of consuming honey pending the need for population or epidemiological studies. The potential public health benefit on metabolic diseases such as obesity, childhood obesity, insulin resistance, type II diabetes, cardiovascular disease, and neuro-degenerative diseases could be enormous. Two years of focused research could have a significant impact on the health of the next generation.

In conclusion, Dr. Fessenden indicated that the results from animal and human research to date indicates that the consumption of honey has been shown to

- Lower blood glucose levels
- Lower HA1c levels
- Lower Triglycerides
- Increase HDL Cholesterol
- Enhance Immune System responses by
    - Increasing Absolute Neutrophil Count
    - Stabilizing hemoglobin levels
    - Increasing platelet count
- Decrease cough in pediatric patients due to URIs

Honey possesses powerful antimicrobial properties that can be utilized now at low cost and at no risk. Finally, honey contains antioxidants, minerals and other bio-active principles that are known to reduce oxidative stress in humans.

As put so wonderfully by Kevin Hughes and Melissa McAllister of Pollock Communications who contributed the initial press release following the Symposium,

"*Eating for your health has never been sweeter."*

Ronald E. Fessenden, MD, MPH
January 21, 2008