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HONEY, SLEEP AND THE "HYMN" CYCLE

Honey may improve sleep quality. The mechanism for this can be described in what the editors call the **Honey-Insulin-Melatonin Cycle** or "HYMN" Cycle.

Each individual step of the cycle is well established and may be found in routine text books of biochemistry. Together, these steps describe a cycle of metabolic activity that culminates in "optimized recovery physiology" during "restorative sleep", and more importantly in the reduction in the release of stress hormones during the night fast. **The cycle begins with the ingestion of 1 to 2 tablespoons of honey in the hour prior to bedtime and proceeds as follows:**

1. The glucose moiety (portion) of honey passes from the gut, through the liver circulation and into the general circulation producing a mild glucose spike. (Glucose from honey produces only a mild or controlled elevation in blood sugar primarily because the fructose moiety facilitates glucose uptake into the liver where it is converted to glycogen. Thus less glucose reaches or remains in the general circulation.)
2. **The mild elevation in blood sugar (from glucose) prompts a mild controlled release of insulin from the pancreas.**
3. The presence of insulin in the general circulation drives tryptophan into the brain.
4. **Tryptophan is converted to serotonin, a key hormone that promotes relaxation.**
5. In darkness, serotonin is converted to melatonin in the pineal gland.
6. **Melatonin activates sleep (by reducing body temperature and other mechanisms).**
7. Melatonin also inhibits the release of more insulin from the pancreas – an example of the wonderfully creative "feedback" or control mechanism of the Hymn Cycle – thus preventing a rapid drop in blood sugar level.
8. **Melatonin promotes the release of growth hormone by another of the curious and round-about routes that the human system excels in. The release of growth hormone is controlled by the activity of a growth-hormone-releasing hormone. This hormone is turn inhibited by another hormone - growth-hormone-releasing-hormone inhibiting hormone. Melatonin inhibits this last hormone, thus preventing the inhibition of growth hormone releasing hormone, and therefore promoting the release of growth hormone from the pituitary gland. Growth hormone is the hormone governing all of recovery physiology. This is the key first step in recovery or restorative physiology that occurs overnight.**
9. Next, a cascade of recovery hormones initiate the repair, maintenance and rebuilding of bone, muscle, and other body tissues. NOTE: For "optimized recovery" to take place, there must be sufficient glycogen stores in the liver. When liver glycogen stores are adequate, "optimized recovery physiology" is almost exclusively fat-burning physiology. Although this seems counterintuitive, the science that documents the burning of fat during rest is well established.
10. **Melatonin also impacts memory consolidation by its requirement for the formation of NCAMS - neural cell adhesion molecules - during REM sleep - and these are necessary for the processing of short term memory from the hippocampus into long term memory in the brain cortex.**
11. Concurrent with the above, the fructose moiety of honey carries out its critical role. Fructose is taken up by the liver where some is converted to glucose and then to liver glycogen, thus providing the brain with a sustained supply of glucose for the night fast. (Without liver glycogen for fuel, the brain only has sufficient glycogen to survive about 30 seconds.)
12. **Additionally, fructose regulates glucose uptake into the liver by prompting release of glucokinase from the hepatocyte nuclei. Glucokinase is found primarily in the liver cell nuclei and is necessary for the conversion of glucose to glycogen. This action of fructose in releasing glucokinase is a wondrous metabolic phenomenon we term "The Fructose Paradox". Thus, fructose insures good liver glycogen supply overnight and prevents a major glucose/insulin spike as referred to in #1 above.**
13. An adequate liver glycogen supply means that stress hormones (released to maintain fuel supply to the brain in the absence of adequate liver glycogen) need not be released. This exceedingly beneficial effect on an individual's hormone profile over time will have a profound impact on the public health concerns regarding obesity, diabetes and other metabolic conditions. **NOTE: In northern Europe and America, the notion that we should not eat before bedtime results in chronic release of adrenal hormones during rest, impacting sleep architecture and resulting over time, in increased risk of heart disease, hypertension, osteoporosis, diabetes, obesity, gastric ulcers, childhood obesity, depression, memory loss and dementias - all conditions associated with chronic release of adrenal hormones.**

Application and Conclusion: After an early evening meal, a tablespoon or two of honey prior to bed will activate the sleep cycle and the recovery cycle. With the consumption of honey before bedtime, sleep quality is improved, recovery (fat burning) physiology is optimized, and the chronic release of adrenal stress hormones is inhibited. It is postulated that by the mechanisms articulated above, the effect will be a reduction in the risk for all the diseases associated with metabolic syndrome referred to in 13 above.

Additional References:

1) Murray RK, Granner DK, Mayes PA, Rodwell, VW, **Harper's Biochemistry,** 22nd Edition, Appleton & Lange,1990
2) Rang HP, Dale MM, **Pharmacology**, Churchill Livingstone, Edinburgh, 1991.
3) Gibney MJ, Macdonald IA, Roche HM, **Nutrition & Metabolism**, Blackwell Publishing, Oxford 2003.