HUMAN HIF TRIGGERED METABOLISM – POSSIBLE IMPACT ON LONGER SPACE AND COMMERCIAL FLIGHTS UNDER MODERATE HYPOXIA

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Moderate to severe hypoxia ($FiO_2 < 0.17$) initiates via HIF changes in the human metabolism on various pathways. Concerning nutrition and the metabolism of carbohydrates, fat, and proteins, the effects of hypoxia and HIF-triggered genes are time, and dose-dependent, and change over time in hypoxia. That knowledge about these hypoxic effects on metabolism might have played a role in nutrition already in ancient humans, who lived or traveled to high altitudes, can be observed in the stomach content of the mummy of the iceman. The stomach content contained mainly animal fat from the neck of a Capricorn and some lower amount of grain. At the time of his death, the Iceman probably was already a few days at an altitude above 3000m. This fits with a time dose response of fat and carbohydrate metabolism in moderate hypoxia. With the onset of hypoxia and the release of HIF the output of the hormone leptin is increased with a short time delay and reduces the storage of fat and release of free fatty acids for energy production in cells. This effect diminishes over time and the human metabolism returns after two to three weeks in hypoxia back to business as usual. The reduced uptake of new fat from nutrition and burning of free fatty acids stop already after a few days and lead to more hunger for fat in food. For long-haul space flights in moderate hypoxia or work at high altitudes, this should have some impact on the nutrition of subjects and their dietary needs. A possible minor weight loss at the beginning of a journey will be compensated with ongoing travel or stay. Since fat metabolism with the hormonal extremely active white and brown fat cells has an impact on the sleep-wake cycle and mood and vigilance, these aspects should be considered when planning a longer journey in moderate hypoxia.