

Preface

During the last two decades, the prevalence of obesity has dramatically increased in western and westernized societies. Its devastating health consequences include hypertension, cardiovascular diseases, or diabetes and make obesity the second leading cause of unnecessary deaths in the USA. As a consequence, obesity has a strong negative impact on the public health care systems. Recently emerging scientific insight has helped understanding obesity as a complex chronic disease with multiple causes. A multileveled gene–environment interaction appears to involve a substantial number of susceptibility genes, as well as associations with low physical activity levels and intake of high-calorie, low-cost, foods. Unfortunately, therapeutic options to prevent or cure this disease are extremely limited, posing an extraordinary challenge for today’s biomedical research community.

Obesity results from imbalanced energy metabolism leading to lipid storage. Only detailed understanding of the multiple molecular underpinnings of energy metabolism can provide the basis for future therapeutic options. Numerous aspects of obesity are currently studied, including the essential role of neural and endocrine control circuits, adaptive responses of catabolic and anabolic pathways, metabolic fuel sensors, regulation of appetite and satiation, sensory information processing, transcriptional control of metabolic processes, and the endocrine role of adipose tissue. These studies are predominantly fuelled by basic research on mammalian models or clinical studies, but these findings were paralleled by important insights, which have emerged from studying invertebrate models.

The sense of taste is a vigilant gatekeeper of our body as it provides important information about substances in our diet, thereby influencing our decisions as to what to eat and drink. The gustatory system has been selected during evolution to detect nonvolatile nutritive and beneficial compounds, e.g., sweet and umami taste identifies the caloric content of food and the sensing of salt plays a crucial role in electrolyte homeostasis. In contrast, sour and bitter tastes have evolved as central warning signals against the ingestion of sour-tasting spoiled food or unripe fruits, as well as potentially toxic substances, including plant alkaloids and other environmental toxins. Consequently, taste perception is coupled to a certain hedonic tone,

with sweet taste being generally perceived as most pleasant and bitter taste causing usually strong aversive reactions.

As important entities in metabolic regulation, taste receptors and their cells appear to be critical elements in efficient feedback control loops allowing dynamic regulations of the gustatory system in response to metabolic signals. For instance, in the mouse, sweet taste sensitivity (via the sweet taste receptor) is inversely correlated with circulating leptin levels, a major satiety factor mainly secreted by adipose tissue. In man, sweet sensitivity is coupled to diurnal variation in leptin levels, and leptin gene, as well as leptin receptor gene, polymorphisms modulate sweet taste sensitivity.

The role of taste receptor genes in gastrointestinal tissue as well as their dynamic regulation in gustatory and nongustatory tissues in response to metabolic cues establishes an entirely new and fast developing research field with impact on fuel sensing, metabolic control, and ingestive behavior. This volume reflects the recent scientific progress in the field of fuel sensing in the mouth, GI tract, and brain. It extends to the olfactory bulb as a metabolic sensor of endocannabinoids or brain insulin and glucose concentrations and the brain–gut endocrine axis. The unexpected finding of the association between autophagy and lipid metabolism in adipose tissue not only provides new insights in the regulation of these complex processes but also highlights possibly novel therapeutic approaches to tackle the metabolic syndrome. This volume also touches relevant novel molecular and cellular mechanisms regulating energy metabolism and causes and consequences of obesity, as well as the identification and functional characterization of obesity genes. Finally, the volume contains chapters illustrating the use of insect models to study relevant problems of energy homeostasis.

The idea for this book developed during the organization of the 30th Blankenese Conference, an international meeting that was sponsored by VolkswagenStiftung and held in May 2010 in Blankenese, a suburb of Hamburg, located in a picturesque setting above the river Elbe. This Conference acknowledged the aforementioned progress we have seen in the fields of sensory and metabolic regulation.

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