International Conference on Clinical Nutrition
May 02, 2022 | Webinar
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Journal of Nutrition and Human Health
https://www.alliedacademies.org/nutrition-human-health/

Leptin modulates fat taste perception in taste papillae

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Received:April 21, 2022, Editor assigned: April 22, 2022, Reviewed: April 29, 2022, QC No. Q-00001;
Published: May 02, 2022, Invoice No. CN-000P1

Biography

Hameed Ullah is PhD student at the Department of Physiology, Nutrition and Cancer, University of Burgundy Dijon France. He is doing research on taste perception specifically

on the taste for fat under the team of NuTOX. This group is committed to 6th taste modality i.e. taste for fat in the microenvironment of taste bud cells. The group has identified the fat taste receptors in tongue papillae of mice. The discovery of fat taste receptors CD36 and GPR120 in taste tissue open a new debate on this new taste modality. Currently I am perusing my last year of research with this group under the title " Role of leptin in the modulation of preference for fat in mice". We have identified for the first time that fat taste receptors co-expressed with leptin receptors in mice taste bud cells. This means that fat eating behaviour might be control from the very beginning of food episode independent of brain gut axis.

Abstract

The prevalence of overweightness and obesity is on the rise throughout the world. Current researches have successfully unveiled, the existence of a gustatory cue, i.e., taste for fat. This gustatory perception might result into overeating behavior. In this study, we used biochemical and behavioral approaches to explore the role of leptin, an anorectic peptide that controls eating behaviour, energy homeostasis and body weight via its action on different areas in the brain of mice. We used the two-bottle preference and licking tests to assess the fat taste perception in mice. Confocal microscopy was used to demonstrate the colocalization of fat taste receptors (CD36 and GPR120) with leptin receptor in mice taste bud cells (TBCs). To explore the role of leptin in the oro-sensory perception of dietary fatty acids, we used RT-qPCR, calcium signaling, ELISA, membrane potential and western-blotting techniques. We conducted experiments on isolated TBC (ex-vivo studies) or on different mice models like genetically modified obese (ob/ob) or diet-induced obese (DIO) mice (in vivo studies) in order to explore the implication of leptin in the modulation of oro-sensory perception of dietary long-chain fatty acids. The in-vitro studies on cultured TBC show that leptin, released from these cells into the micro-environment of papillae of the tongue, modulates fat preference in wild type mice. Leptin suppressed the dietary fatty acid in these mice but surprisingly, administration of exogenous leptin increased fat taste sensitivity in ob/ob mice. The DIO mice, leptin shows no significant response which might be due to leptin resistance. Our results shows for the first time that leptin receptors are co-expressed with fat taste receptors in TBC and may control fat eating behaviour via its local action, probably in an autocrine manner, in the taste papillae, and also via its peripheral action. Finally, we can say that leptin might control preference for fat at different levels by modulating the sensitivity of fat taste. The increase in sensitivity to fatty acids solutions decrease the intake of fat/lipids which might reduce the incidence of overweight and obesity in mice.

Key words:
CD36; obesity; fat taste

Importance of Research: Obesity is considered a multifactorial cosmopolitan medical condition associated with several other critical health complications. In 2003, the World Health Organization (WHO) reported that more than one billion people on this planet were overweight, of which nearly 800 million were clinically obese. The situation of obesity is predominantly the result of the accumulation of high fat, due to an imbalance of energy intake and energy expenditure.

The sense of taste informs the organism about the quality of ingested food. There are, so far identified, five basic taste qualities, i.e., sweet, sour, bitter, salty and umami. Recent compelling evidence from rodent and human studies raises the possibility for an additional 6th taste quality, devoted to the perception of dietary fat. Hence, two principal glycoproteins, CD36 and GPR120, are involved in fat taste perception. The CD36 is a scavenger receptor, whereas GPR120 is a GPCR and belongs to seven trans-membrane domain receptors family. The implication of CD36 in the gustatory perception of fat was shown by employing the double-choice test. The experiments on wild type and CD36 knock-out mice demonstrated that the latter animals completely failed to exhibit the preference for dietary fatty acids. We have shown that CD36 and GPR120 act in a synergic and complementary fashion to control fat eating behaviour.

Leptin, the product of ob (obese) gene, is produced by the adipose tissues and other organs. Leptin promotes weight loss, by stimulating the rate of metabolism and suppressing appetite. Leptin also signals on the nutritional status to several other physiological systems and modulates their functions. The defect in ob gene contributes to suppressed leptin production and, ultimately, causes diabetes and development of severe obesity.

Several factors have been shown to influence fat intake and the control of food behaviour. The hormone/peptides released by gut during post-prandial phase of food intake trigger satiation. The agents like glucagon-like peptide-1 (GLP-1), cholecystokinin (CCK), neuropeptide-Y (NPY), pancreatic polypeptide, and ghrelin modulate food ingestion. Leptin and insulin signal the adiposity in both short and long-term energy balance homeostasis. It is interesting to mention that these gut-derived peptides/hormones have a short half-life, and they are rapidly degraded during food episode. Hence, several recent studies have demonstrated that taste buds also release a number of these peptides/hormones including leptin and CCK and control oro-cephalic phase of food intake. Leptin is a very interesting hormone as it is released not only by epithelial cells of the stomach but also by lingual papillae in the vicinity of taste bud cells. However, no study is available on the role of leptin, particularly that released by taste papillae, in the modulation of dietary fat intake. In this study, we propose to assess the implication of tongue leptin in the orosensory perception of a dietary long-chain fatty acid in mice.