Exploring ghrelin and leptin signalling in hedonic hunger: Moringa oleifera as a natural intervention for obesity

Farah Hanis Juhari[1], Nur Maya Sabrina Tizen Laim[2], Azlina Zulkapli[3], Hendra Susanto[4]

[1]Department of Biosciences, Faculty of Science, Universiti Teknologi Malaysia, 81300 Johor, Malaysia, [2]Department of Pathology, Faculty of Medicine, Universiti Kebangsaan Malaysia, 56000 Cheras, Kuala Lumpur, Malaysia, [3]Laboratory Animal Resource Unit (LARU), Special Resource Centre, Institute for Medical Research, National Institute of Health, Ministry of Health Malaysia, 50588 Kuala Lumpur, Malaysia, [4]Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Indonesia

ABSTRACT

Introduction: Obesity has become a global epidemic, with rates doubling in adults and quadrupling in adolescents since 1990. One of the major contributors to obesity is hedonic hunger, where individuals eat for pleasure rather than energy balance. This behaviour is driven by the brain's reward system and often involves a preference for highly palatable foods rich in fat and sugar. Therefore, this review examines the potential effects of Moringa oleifera on the regulation of ghrelin, leptin, and hedonic hunger in obesity. **Materials and Methods and Results:** Central to hedonic hunger is ghrelin, a hormone primarily produced in the gastrointestinal tract and known as the "hunger hormone." Ghrelin stimulates appetite by acting on both homeostatic and non-homeostatic pathways through its receptor GHSR1a, which is abundantly expressed in the hypothalamus, ventral tegmental area (VTA), and nucleus accumbens (NAcc). While ghrelin typically rises before meals to stimulate eating, studies have shown that obese individuals often exhibit lower circulating ghrelin levels compared to healthy individuals and those with anorexia nervosa. This paradox suggests a dysregulation of ghrelin signalling in obesity. Furthermore, ghrelin has been positively associated with a preference for palatable and sugary foods, reinforcing its role in hedonic eating. In contrast, leptin, a satiety hormone secreted mainly by adipose tissue, regulates energy balance by promoting satiety and inhibiting ghrelin secretion. Leptin levels are strongly correlated with body fat percentage and are typically elevated in obese individuals. However, chronic elevation can lead to leptin resistance, impairing its effectiveness in regulating appetite and energy expenditure. Together, disruptions in ghrelin and leptin signalling are key features in the pathophysiology of obesity and hedonic hunger. Given the limitations and potential side effects of conventional anti-obesity drugs, there is growing interest in herbal remedies as safer, alternative treatments. Moringa oleifera, a plant native to India and widely cultivated in Southeast Asia including Malaysia, has gained attention for its nutritional and medicinal properties. Rich in vitamins (A, C, E), minerals (calcium, potassium, iron), amino acids, and bioactive compounds such as polyphenols, flavonoids, and glucosinolates, M. oleifera was recognized by the World Health Organization (WHO) in 1998 as a promising natural remedy. Recent studies have highlighted M. oleifera's anti-obesity and antidiabetic effects, including reduction in lipid accumulation in the liver and adipose tissue, improvement in lipid profiles, and enhanced glucose tolerance in high-fat diet-induced obese rats. Although studies directly examining the effects of M. oleifera on ghrelin and hedonic hunger remain limited, early findings suggest that it may increase plasma ghrelin levels, indicating its potential to help restore appetite regulation in individuals with obesity. Additionally, its leaf extract has been shown to downregulate leptin and resistin gene expression, reduce circulating adipokines, and exert potent anti-inflammatory and antioxidant effects. **Conclusion:** In conclusion, Moringa oleifera demonstrates promise as a therapeutic agent for obesity by modulating key appetite-regulating hormones such as ghrelin and leptin, and may offer a natural, safer strategy for addressing hedonic eating and metabolic dysregulation.

Keywords: Ghrelin, Leptin, Moringa oleifera, Hedonic hunger, Obesity