



REVIEW ARTICLE

Natural anti-obesity agents



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Abstract Obesity is a complex disease caused by the interaction of a myriad of genetic, dietary, lifestyle, and environmental factors, which favors a chronic positive energy balance, and leads to increased body fat mass. The incidence of obesity is rising at an alarming rate and is becoming a major public health concern with incalculable social costs. Indeed, obesity facilitates the development of metabolic disorders such as diabetes, hypertension, and cardiovascular diseases in addition to chronic diseases such as stroke, osteoarthritis, sleep apnea, some cancers, and inflammation-based pathologies. Recent researches demonstrated the potential of natural products to counteract obesity. Multiple-natural product combinations may result in a synergistic activity that increases their bioavailability and action on multiple molecular targets, offering advantages over chemical treatments. In this review, we discuss the anti-obesity potential of natural products and analyze their mechanisms.

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Abbreviations: WHO, World Health Organization; BMI, body mass index; WHR, Waist to Hip Ratio; WC, Waist Circumference; FTO, fat mass and obesity associated; MC4R, melano-cortin-4 receptor; POMC, proopiomelanocortin; DRD4, dopamine receptor D4; PPAR γ 2, peroxisome proliferator-activated receptor γ 2; HDL, high-density lipoprotein; LDL, low-density lipoproteins; TG, triglyceride; WLS, Weight Loss Surgery; ABA, abscisic acid; CVD, cardiovascular diseases; BAT, brown adipose tissue; UCPI, Uncoupling protein; PUFA, polyunsaturated fatty acids; HCA, hydroxycitric acid.

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1. Introduction

In 1997, the World Health Organization (WHO) described obesity as an epidemic hazard worldwide, based on the data analysis of body mass index (BMI).¹ Since then, obesity incidence increased at an alarming rate and is becoming a major public health concern.² Indeed, obesity facilitates the development of metabolic disorders (e.g. diabetes, hypertension), and cardiovascular diseases in addition to chronic diseases (e.g. stroke, osteoarthritis, sleep apnea, cancers, and inflammation-based pathologies).^{3,4} According to studies in different countries, an obese person incurs health care expenditures at least 25% higher than a healthy person.⁵ Adding production losses to health care costs, obesity accounts for a considerable percentage loss of gross domestic product in most countries (>1% in US, >3.6% in China).⁶

Obesity could be iatrogenic, i.e. secondary to drug treatments (antipsychotic, antidepressant, antiepileptic, steroids, and insulin), or due to certain diseases (Cushing syndrome, hypothyroidism, and hypothalamic defects).⁷ Obesity as a primary disorder follows a positive energy balance. The identification of the primary causes of this imbalance

remains challenging and comprises the majority of cases usually diagnosed after causes for secondary obesity are ruled out.⁸ This chronic disease results from complex interactions of genetic, behavioral, and environmental factors correlating with economic and social status and lifestyles.⁹ In fact, obesity is more frequent in populations living in environments characterized by a long-term energy positive imbalance due to sedentary lifestyle, low resting metabolic rate, or both.¹⁰ Causes of obesity involve genes, metabolism, diet, physical activity, and the socio-cultural environment that characterizes 21st century living style.¹¹ The identification of potential molecular targets susceptible to be manipulated from external factors, particularly food and drug agents may assist people in gaining control over appetite allowing obesity prevention. Nutritional genomics could determine which specific nutrients bring phenotypic changes that influence the obesity risk and could establish which interactions are the most important.¹²

Global strategies are focused on dietary and lifestyle modifications, i.e. restrict calorie intake and increase physical activity to slow obesity development.¹³ Researches demonstrated the potential of natural products to counteract obesity.¹⁴ Multiple natural product combinations may result in a

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