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6. Diabetes, Obesity, and Metabolic Diseases

6.1. Biomedical Approaches Involving the Carob Tree (Ceratonia siliqua L.) for the Management of Obesity and Diabetes

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The carob tree (*Ceratonia siliqua* L.), a traditional Mediterranean plant, stands out as a promising natural solution in the fight against obesity and diabetes, two major public health issues worldwide. This plant is rich in dietary fiber, polyphenols, and various bioactive compounds that act synergistically to prevent and reduce the metabolic imbalances associated with these pathologies. Among its assets, carob promotes satiety, reduces fat absorption, and positively modulates intestinal microbiota, key mechanisms for improving weight management and blood-sugar regulation.

On the metabolic front, carob extracts help regulate blood sugar and insulin, thereby limiting the complications associated with obesity, such as type 2 diabetes and cardiovascular disease. The underlying biological mechanisms include the inhibition of the digestive enzymes responsible for the breakdown and absorption of carbohydrates and lipids, resulting in improved glycemic stability and a significant reduction in caloric intake. The dietary fibers contained in carob play an important satiety-enhancing role, reducing the sensation of hunger and promoting better food management.

In addition, the modulation of the intestinal microbiota by carob bioactive compounds improves carbohydrate and lipid metabolism, enhancing energy balance. Its powerful antioxidant properties reduce oxidative stress and chronic inflammation, two key factors in the pathophysiology of obesity and diabetes. Carob also acts on fat metabolism by stimulating lipolysis (the breakdown of stored fat) and inhibiting lipogenesis (the formation of new fat).

These multiple properties position the carob tree as an essential resource for the development of natural and sustainable therapies against obesity, diabetes, and their associated complications. This study highlights the potential biomedical applications of carob extracts, offering an innovative and ecological perspective for the prevention and management of these metabolic disorders in an integrative and sustainable approach.

6.2. Exploring the Role of Oral Antidiabetic Medications as Adjuncts in Depression Treatment

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Depression is a complex and multifaceted disorder with a poorly defined etiology and numerous risk factors. Despite the availability of several antidepressant classes, many treatments have limitations that compromise their effectiveness and impact patients' quality of life. Depression and diabetes share pathophysiological mechanisms, such as insulin resistance, inflammation, and neuroplasticity. This review aims to explore the potential of oral antidiabetic therapy as an alternative or adjunct treatment for depression by examining preclinical studies to understand its mechanisms of action and clinical studies to evaluate

its therapeutic efficacy. A bibliographic search was conducted in the PubMed database, and articles were selected using defined inclusion and exclusion criteria. The selected studies were categorized into two groups: preclinical studies and clinical studies. A detailed analysis was conducted for each study using a structured reading form. Key findings highlighted Metformin and Pioglitazone as the most studied drugs with promising effects. Preclinical studies showed that Metformin reduced depression-like behaviors in animal models, and when combined with conventional antidepressants, it enhanced their therapeutic effect. Similarly, Pioglitazone demonstrated significant antidepressant properties by alleviating depressive symptoms in clinical settings, particularly in patients with concurrent depression and diabetes. The mechanisms identified in these studies, including the modulation of insulin resistance and improvements in neuroplasticity, provide insight into the efficacy of oral antidiabetic therapy for depression. These findings suggest a dual benefit for patients with comorbid diabetes and depression. While the evidence supports the potential role of these therapies, further research is required to optimize treatment protocols, investigate long-term outcomes, and expand the understanding of the underlying biological pathways.

6.3. A Systematic Review of the Potential Applications of Nutrigenomics to Prevent and Alleviate Metabolic Disorders

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Metabolic disorders (MDs) are characterized by disruptions in normal metabolic processes, often leading to impaired carbohydrate, lipid, or protein metabolism. These disorders, including diabetes mellitus, phenylketonuria, and lysosomal storage diseases, occur due to genetic mutations, environmental influences, or their interplay. In recent decades, nutrigenomics (NG) has arisen as a promising field, in which nutrition plays a key role in understanding the interactions between nutrients and gene expressions. By elucidating the molecular mechanisms linking dietary components to metabolic pathways, NG enables the development of personalized nutrition strategies that could prevent or alleviate MDs. For instance, individuals with type 2 diabetes may benefit from dietary modifications targeting genes that are involved in insulin signaling pathways, while those with phenylketonuria require tailored diets that are low in phenylalanine. Advances in NG technologies, such as transcriptomics and epigenomics, have revealed how nutrients influence gene expression through different mechanisms, including DNA methylation and histone modification. These findings underscore the importance of dietary patterns in mitigating the risk of MDs and improving disease outcomes. Furthermore, NG contributes to precision medicine by identifying genetic polymorphisms that affect nutrient metabolism and enabling interventions that are aligned with an individual's genetic profile. As research progresses, the integration of NG into clinical practice holds potential to revolutionize the prevention and management of metabolic disorders, promoting improved health outcomes. This systematic review aims to compile and analyze the current evidence on the role of NG in the prevention of MDs, focusing on its potential application in precision and preventive medicine. By synthesizing recent findings, this review highlights opportunities and limi-