CHAPTER 2

FUNCTIONAL FOODS FOR OBESITY MANAGEMENT

Mustafa Metin DONMA[1]
Orkide DONMA[2]

INTRODUCTION

Obesity is a global health problem in both developed and developing countries. The prevalence of obesity, which is related to many metabolic disorders, such as diabetes mellitus, metabolic syndrome, cardiovascular diseases, non-alcoholic fatty liver disease and some cancers-, is increasing among all fractions of the population, including children, adolescents and adults. Aside from these diseases, it may also lead to some psychological problems, such as depression. At the same time, it is also a social problem, which adds a significant burden on health care systems. Quite many pharmacological and/or surgical solutions to treat obesity are in current use. Within this context, some drugs such as orlistat and bariatric surgery may be mentioned. However, especially in the presence of cardiovascular diseases, they may aggravate the clinical picture. [1-5]

In the meantime, alternative medicine offers some medicinal herbs to prevent and even, in some cases, to treat obesity. Each of these plants contains many bioactive compounds, which have been suggested as safe anti-obesity resources. Upon investigation of their action mechanisms, various routes have been clarified. Inhibition of enzymes concerning lipid and carbohydrate metabolisms, modulation of some certain signaling pathways are some of these mechanisms. [1, 6-10]

Recently, the interrelationship between white and brown adipose tissues has gained importance. The association between the amount of brown adipose tissue and the amount of energy expenditure is well-known. Therefore, the participation of bioactive components found in some plants into the brown adipose tissue and white adipose tissue metabolisms has drawn attention. Adipocyte browning is a promising strategy for obesity prevention. The plants, which stimulate the conversion of white adipocytes to brown adipocytes or inhibit the differentiation of

1 Prof. Dr., Tekirdag Namik Kemal University, Faculty of Medicine, Department of Pediatrics, mdonma@gmail.com

2 Prof. Dr., Istanbul University-Cerrahpasa, Cerrahpasa Medical Faculty, Department of Medical Biochemistry, donmaohm@istanbul.edu.tr

The people with chronic diseases may prefer to proceed with phytotherapeutic applications during their treatments. They may believe that such a therapy will be less harmful for their body. However, if a plant has a pharmacological effect, it will also have side effects. For instance, flavonoids, alkaloids, terpenes, have been reported to possess hypoglycemic effects.[64] Onion ameloriates hyperglycemia and insulin resistance.[65] Garlic causes significant decreases in fasting blood glucose and glycated hemoglobin levels.[66] Garlic also demonstrates a hypotensive effect. [67] Cinnamon, due to its coumarin content, acts as a powerful anticoagulant. Coadministration of cinnamon and ginger with dabigatran significantly increases the risk of bleeding.[68,69]

In conclusion, the benefits and importance of bioactive components in medicinal plants cannot be underestimated when obesity prevention and treatment are taken into consideration. However, their multi-target activities should also be widely investigated.

REFERENCES

1. Bae J, Kumazoe M, Fujimura Y, et al. Diallyl disulfide potentiates anti-obesity effect of green tea in high-fat/high-sucrose diet-induced obesity. J Nutr Biochem. 2019; 64:152-61.
2. Sayed S, Ahmed M, El-Shehawi A, et al. Ginger water reduces body weight gain and improves energy expenditure in rats. Foods. 2020; 9(1). pii: E38.
3. Lu M, Cao Y , Xiao J , et al. Molecular mechanisms of the anti-obesity effect of bioactive ingredients in common spices: a review. Food Funct. 2018; 9(9):4569-81.
4. de Freitas Junior LM, de Almeida Jr EB. Medicinal plants for the treatment of obesity: ethnopharmacological approach and chemical and biological studies. Am J Transl Res. 2017; 9(5): 2050-2064.
5. Li Z, Maglione M, Tu W, et al. Meta-analysis: Pharmacologic treatment of obesity. Ann Intern Med. 2005; 142(7): 532-40.
6. Wang J, Li D, Wang P, et al. Ginger prevents obesity through regulation of energy metabolism and activation of browning in high-fat diet-induced obese mice. J Nutr Biochem. 2019; 70:105-15.
7. Wang J, Zhang L, Dong L, et al. 6-gingerol, a functional polyphenol of ginger, promotes browning through an AMPK-dependent pathway in 3T3-L1 adipocytes. J Agric Food Chem. 2019; 67(51):14056-65.
8. Buchholz T, Melzig MF. Medicinal plants traditionally used for treatment of obesity and diabetes mellitus – Screening for pancreatic lipase and α-amylase inhibition. Phytother Res. 2016; 30(2): 260–6.
9. Herranz-López M, Olivares-Vicente M, Encinar JA, et al. Multi-targeted molecular effects of Hibiscus sabdariffa polyphenols: An opportunity for a global approach to obesity. Nutrients 2017; 9(907):1-26.
10. Ojulari OV, Lee SG, Nam JO. Beneficial effects of natural bioactive compounds from Hibiscus sabdariffa L. on obesity. Molecules. 2019; 24(1):210.
11. Lee SG, Parks JS, Kang HW. Quercetin, a functional compound of onion peel, remodels white adipocytes to brown-like adipocytes. J Nutr Biochem. 2017; 42:62-71.
12. Srivastava S, Veech RL. Brown and brite: The fat soldiers in the anti-obesity fight. Front Physiol. 2019; 10:38.
13. Sagayaraj IR, Akılashree S, Brındha Devi P. Induction of brown adipose tissue: a review. Asian J Pharm Clin Res, 2018; 11(5): 472-476

14. Zhang J, Wu H, Ma S, et al.Transcription regulators and hormones involved in the development of brown fat and white fat browning: Transcriptional and hormonal control of brown/beige fat development. Physiol Res. 2018; 67: 347-362.
15. Trichur Khabeer S, Prashant A, Haravey Krishnan M. Dietary fatty acids from pomegranate seeds (Punica granatum) inhibit adipogenesis and impact the expression of the obesity-associated mRNA transcripts in human adipose-derived mesenchymal stem cells. J Food Biochem. 2019; 43(3): e12739.
16. Baek SC, Nam KH, Yi SA, et al. Anti-adipogenic effect of β-carboline alkaloids from Garlic (Allium sativum). Foods. 2019; 8(12). pii: E673.
17. Zarei A, Changizi-Ashtiyani S, Taheri S, et al. A quick overview on some aspects of endocrinological and therapeutic effects of Berberis vulgaris L. Avicenna J Phytomed. 2015; 5(6): 485-97.
18. Xu JH, Liu XZ, Pan W, et al. Berberine protects against diet-induced obesity through regulating metabolic endotoxemia and gut hormone levels. Mol Med Rep. 2017; 15:2765-87.
19. Tabeshpour J, Imenshahidi M, Hosseinzadeh H. A review of the effects of Berberis vulgaris and its major component, berberine, in metabolic syndrome. Iran J Basic Med Sci. 2017; 20:557-68.
20. Mousavi SM, Rahmani J, Kord-Varkaneh H, et al. Cinnamon supplementation positively affects obesity: A systematic review and dose-response meta-analysis of randomized controlled trials. Clin Nutr. 2020; 39(1):123-33.
21. Khedr NF, Ebeid AM, Khalil RM. New insights into weight management by orlistat in comparison with cinnamon as a natural lipase inhibitor. Endocrine. 2020; 67(1):109-16.
22. Neto JGO, Boechat SK, Romão JS, et al. Treatment with cinnamaldehyde reduces the visceral adiposity and regulates lipid metabolism, autophagy and endoplasmic reticulum stress in the liver of a rat model of early obesity. J Nutr Biochem. 2019; 77:108321.
23. Jain SG, Puri S, Misra A, et al. Effect of oral cinnamon intervention on metabolic profile and body composition of Asian Indians with metabolic syndrome: a randomized double-blind control trial. Lipids Health Dis. 2017; 16(113):1-11.
24. Gurley BJ, Steelman SC, Thomas SL. Multi-ingredient, caffeine-containing dietary supplements: History, safety, and efficacy. Clin Ther. 2015; 37(2): 275-301.
25. Harpaz E, Tamir S, Weinstein A, et al. The effect of caffeine on energy balance. J Basic Clin Physiol Pharmacol. 2017; 28(1): 1–10.
26. Chahal AK, Chandan G, Kumar R, et al. Bioactive constituents of Emblica officinalis overcome oxidative stress in mammalian cells by inhibiting hyperoxidation of peroxiredoxins. J Food Biochem. 2019: e13115.
27. Nazish I, Ansari SH. Emblica officinalis – Anti-obesity activity. J Compl Integ Med. 2018; 20160051.
28. Variya BC, Bakrania AK, Patel SS. Antidiabetic potential of gallic acid from Emblica officinalis: Improved glucose transporters and insulin sensitivity through PPAR-γ and Akt signaling. Phytomedicine. 2019: 152906.
29. Quesada I, de Paola M, Torres-Palazzolo C, et al. Effect of garlic's active constituents in inflammation, obesity and cardiovascular disease. Curr Hypertens Rep. 2020; 22(1):6.
30. Darooghegi Mofrad M, Rahmani J, Varkaneh HK. The effects of garlic supplementation on weight loss: A systematic review and meta-analysis of randomized controlled trials. Int J Vitam Nutr Res. 2019: 1-13.
31. Irfan M, Kim M, Kim KS, et al. Fermented garlic ameliorates hypercholesterolemia and inhibits platelet activation. Evid Based Complement Alternat Med. 2019; 2019:3030967.
32. Maharlouei N, Tabrizi R, Lankarani KB, et al. The effects of ginger intake on weight loss and metabolic profiles among overweight and obese subjects: A systematic review and meta-analysis of randomized controlled trials. Crit Rev Food Sci Nutr. 2019; 59(11):1753-66.
33. Kim S, Lee MS, Jung S, et al. Ginger extract ameliorates obesity and inflammation via regulating microRNA-21/132 expression and AMPK activation in white adipose tissue. Nutrients. 2018; 10(11):1567.

34. Abdullah A, Butt MS, Shahid M, et al. Evaluating the antimicrobial potential of green cardamom essential oil focusing on quorum sensing inhibition of Chromobacterium violaceum. J Food Sci Technol. 2017; 54(8):2306-15.
35. Daneshi-Maskooni M, Keshavarz SA, Qorbani M, et al. Green cardamom increases Sirtuin-1 and reduces inflammation in overweight or obese patients with non-alcoholic fatty liver disease: a double-blind randomized placebo-controlled clinical trial. Nutr Metab. 2018; 15(63):1-12.
36. Daneshi-Maskooni M, Keshavarz SA, Qorbani M, et al. Green cardamom supplementation improves serum irisin, glucose indices, and lipid profiles in overweight or obese nonalcoholic fatty liver disease patients: a double-blind randomized placebo controlled clinical trial. BMC Comp Alter Med. 2019; 19(59):1-11.
37. Aghasi M, Koohdani F, Qorbani M, et al. Beneficial effects of green cardamom on serum SIRT1, glycemic indices and triglyceride levels in patients with type 2 diabetes mellitus: a randomized double-blind placebo controlled clinical trial. J Sci Food Agric. 2019; 99(8):3933-40.
38. Chowdhury A, Sarkar J, Chakraborti T, et al. Protective role of epigallocatechin-3-gallate in health and disease: a perspective. Biomed Pharmacother. 2016; 78:50–9.
39. Janssens PL, Hursel R, Westerterp-Plantenga MS. Nutraceuticals for bodyweight management: the role of green tea catechins. Physiol Behav. 2016; 162:83–7.
40. Nabi BN, Sedighinejad A, Haghighi M, et al. The anti-obesity effects of green tea: A controlled, randomized, clinical trial. Iran Red Crescent Med J. 2018; 20(1):e55950.
41. Zheng G, Sayama K, Okubo T, et al. Anti-obesity effects of three major components of green tea, catechins, caffeine and theanine, in mice. in vivo. 2004; 18: 55-62.
42. Nishimura M, Muro T, Kobori M, et al. Effect of daily ingestion of quercetin-rich onion powder for 12 weeks on visceral fat: A randomised, double-blind, placebo-controlled, parallel-group study. Nutrients. 2019; 12(1). pii: E91.
43. Yang C, Li L, Yang L, et al. Anti-obesity and hypolipidemic effects of garlic oil and onion oil in rats fed a high-fat diet. Nutr Metab (Lond). 2018; 15:43.
44. Kang B, Kim CY, Hwang J, et al. Punicalagin, a Pomegranate-Derived Ellagitannin, Suppresses Obesity and Obesity-Induced Inflammatory Responses Via the Nrf2/Keap1 Signaling Pathway. Mol Nutr Food Res. 2019; 63(22):e1900574.
45. Mashmoul M, Azlan A, Khaza'ai H, et al. Saffron: A natural potent antioxidant as a promising anti-obesity drug. Antioxidants. 2013; 2: 293-308.
46. Abedimanesh N, Bathaie SZ, Abedimanesh S, et al. Saffron and crocin improved appetite, dietary intakes and body composition in patients with coronary artery disease J Cardiovasc Thorac Res. 2017; 9(4):200-8.
47. Nowak A, Zakłos-Szyda M, Błasiak J, et al. Potential of Schisandra chinensis (Turcz.) Baill. in human health and nutrition: A review of current knowledge and therapeutic perspectives.Nutrients. 2019; 11(333):1-20.
48. Jang MK, Yun YR, Kim JH, et al. Gomisin N inhibits adipogenesis and prevents high-fat diet-induced obesity. Sci Rep. 2017; 7:40345.
49. Jung DY, Kim JH, Lee H, et al. Antidiabetic effect of gomisin N via activation of AMP-activated protein kinase. Biochem Biophys Res Commun. 2017; 494(3-4):587-93.
50. Kwan HY, Wu J, Su T, et al. Schisandrin B regulates lipid metabolism in subcutaneous adipocytes. Sci Rep. 2017; 7(1):10266.
51. Grossini E, Farruggio S, Raina G, et al. Effects of genistein on differentiation and viability of human visceral adipocytes. Nutrients. 2018; 10 (978): 1-18.
52. Jin T, Song Z, Weng J, et al. Curcumin and other dietary polyphenols: potential mechanisms of metabolic actions and therapy for diabetes and obesity. Am J Physiol Endocrinol Metab. 2018; 314: E201–E5.
53. Wang S, Wang X, Ye Z, et al. Curcumin promotes browning of white adipose tissue in a norepinephrine-dependent way. Biochem Biophys Res Commun. 2015; 466: 247–53.
54. Li Y, Wong K, Giles A, et al. Hepatic SIRT1 attenuates hepatic steatosis and controls energy balance in mice by inducing fibroblast growth factor 21. Gastroenterology. 2014; 146: 539–49.e7.

55. Zeng K, Tian L, Patel R, et al. Diet polyphenol curcumin stimulates hepatic Fgf21 production and restores its sensitivity in high fat diet fed male mice. Endocrinology. 2017; 158: 277–292.
56. Zhang YJ, Xiang H, Liu J-S, et al. Study on the mechanism of AMPK signaling pathway and its effect on apoptosis of human hepatocellular carcinoma SMMC-7721 cells by curcumin. Eur Rev Med Pharmacol Sci. 2017; 21: 1144–50.
57. Anhê FF, Varin TV, Le Barz M, et al. Gut Microbiota dysbiosis in obesity-linked metabolic diseases and prebiotic potential of polyphenol-rich extracts. Curr Obes Rep. 2015; 4: 389–400.
58. Albert MA, Glynn RJ, Ridker PM. Plasma concentration of C-reactive protein and the calculated Framingham coronary heart disease risk score. Circulation. 2003; 108:161–5.
59. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med. 2006; 3(11):e442.
60. Bixby M, Spieler L, Menini T, et al. Ilex paraguariensis extracts are potent inhibitors of nitrosative stress: a comparative study with green tea and wines using a protein nitration model and mammalian cell cytotoxicity. Life Sci. 2005; 77(3):345–58.
61. Balsan G, Pellanda LC, Sausen G, et al. Effect of yerba mate and green tea on paraoxonase and leptin levels in patients affected by overweight or obesity and dyslipidemia: a randomized clinical trial. Nutr J. 2019; 18(5):1-10.
62. Rinaldi de Alvarenga JF, Quifer-Rada P, Francetto Juliano F, et al. Using extra virgin olive oil to cook vegetables enhances polyphenol and carotenoid extractability: A Study applying the sofrito technique. Molecules. 2019; 24(8):1555.
63. Bagetta D, Maruca A, Lupia A, et al. Mediterranean products as promising source of multi-target agents in the treatment of metabolic syndrome. Eur J Med Chem. 2020; 186:111903.
64. Heinrich M, Jäger AK. Ethnopharmacology. Ch. 20. Diabetes and metabolic disorders: An ethnopharmacological perspective, John Wiley & Sons, 2015; 236.
65. Jafarpour-Sadegh F, Montazeri V, Adili A, et al. Consumption of fresh yellow onion ameliorates hyperglycemia and insulin resistance in breast cancer patients during doxorubicin-based chemotherapy: A randomized controlled clinical trial. Integr Cancer Ther. 2017; 16(3):276–89.
66. Shabani E, Sayemiri K, Mohammadpour M. The effect of garlic on lipid profile and glucose parameters in diabetic patients: A systematic review and meta-analysis. Prim Care Diabetes. 2019; 13(1):28–42.
67. Chan WJJ, McLachlan AJ, Luca EJ, et al. Garlic (Allium sativum L.) in the management of hypertension and dyslipidemia – A systematic review. J Herbal Med. 2019; 100292,
68. Woehrlin F, Fry H, Abraham K, et al. Quantification of flavoring constituents in cinnamon: high variation of coumarin in cassia bark from the German retail market and in authentic samples from indonesia. J Agric Food Chem. 2010; 58(19):10568–75.
69. Maadarani O, Bitar Z, Mohsen M. Adding herbal products to direct-acting oral anticoagulants can be fatal. Eur J Case Rep Intern Med. 2019; 6(8):001190.