

Magdalena Małachowska^{1,2}, Ewa Rusak³, Agata Chobot⁴, Przemysław Jarosz-Chobot³

Dark chocolate as a source of polyphenols – a health-promoting component and a valuable element of a balanced diet supporting a healthy lifestyle: a review

Ciemna czekolada jako źródło polifenoli – składnik o właściwościach prozdrowotnych i cenny element zbilansowanej diety wspierającej zdrowy styl życia: przegląd

¹ Students' Scientific Association at the Department of Children's Diabetology and Lifestyle Medicine, Medical University of Silesia, Katowice, Poland

² Faculty of Medicine, Medical University of Warsaw, Warsaw, Poland

³ Department of Children's Diabetology and Lifestyle Medicine, Medical University of Silesia, Katowice, Poland

⁴ Department of Paediatrics, Institute of Medical Sciences, University of Opole, Opole, Poland

Correspondence: Magdalena Małachowska, Medical University of Silesia, Medyków 16, 40-752 Katowice, e-mail: mmalachowska25@gmail.com

¹ Studenckie Koło Naukowe przy Klinice Diabetologii Dziecięcej i Medycyny Stylu Życia, Śląski Uniwersytet Medyczny w Katowicach, Katowice, Polska

² Wydział Lekarski, Warszawski Uniwersytet Medyczny, Warszawa, Polska

³ Klinika Diabetologii Dziecięcej i Medycyny Stylu Życia, Śląski Uniwersytet Medyczny w Katowicach, Katowice, Polska

⁴ Klinika Pediatrii, Instytut Nauk Medycznych, Uniwersytet Opolski, Polska

Adres do korespondencji: Magdalena Małachowska, Śląski Uniwersytet Medyczny, ul. Medyków 16, 40-752 Katowice, e-mail: mmalachowska25@gmail.com

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ORCID iDs

1. Magdalena Małachowska <https://orcid.org/0009-0008-2147-4316>

2. Ewa Rusak <https://orcid.org/0000-0002-4422-7704>

3. Agata Chobot <https://orcid.org/0000-0002-9622-4433>

4. Przemysław Jarosz-Chobot <https://orcid.org/0000-0002-1120-0994>

Abstract

Context and objective: Dark chocolate is a widely available source of polyphenols that can be easily incorporated into the regular diet of individuals. The purpose of the study was to determine whether dark chocolate is a beneficial substance and whether it should be regarded as a valuable element of a nourishing diet. **Materials and Methods:** To evaluate potential health benefits from regular consumption, the impact of dark chocolate intake on such health aspects as the cardiovascular system, the gut–brain axis, as well as carbohydrate metabolism and obesity treatment, was investigated through the analysis of available recent studies on this topic. **Results:** Analysis of beneficial properties of different types of dark chocolates shows that those with the highest cocoa content usually contain the highest amounts of polyphenols, which are mainly responsible for the positive health effects of dark chocolate consumption. **Conclusions:** Therefore, more attention should be paid to the polyphenol content of dark chocolate rather than cocoa percentage only. The presented data suggest that the preferred type of dark chocolate resulting in beneficial health outcomes should be contain 80% (or at least 70%) of cocoa. Moreover, there is a need for proper nutrition education from an early age, as eating habits developed during childhood influence food preferences and dieting schemes in adulthood.

Keywords: chocolate, polyphenols, diet healthy, functional food

Streszczenie

Cel: Ciemna czekolada stanowi szeroko dostępne źródło polifenoli, które w prosty sposób może zostać uwzględnione w codziennej diecie. Celem artykułu była analiza, jakie potencjalne korzyści może przynosić spożywanie ciemnej czekolady oraz czy może być ona postrzegana jako cenny element żywienia dla organizmu diety. **Materiał i metody:** Aby zbadać potencjalne korzyści zdrowotne wynikające z regularnego spożycia ciemnej czekolady, przeanalizowano jej wpływ na układ sercowo-naczyniowy, metabolizm węglowodanów, jak również funkcjonowanie osi jelitowo-mózgowej i utrzymanie prawidłowej masy ciała. W tym celu posłużono się analizą dostępnych badań i piśmiennictwa na ten temat. **Wyniki:** Po uwzględnieniu korzyści wynikających ze spożycia różnych rodzajów ciemnej czekolady można stwierdzić, że produkty charakteryzujące się najwyższą

zawartością masy kakaowej dostarczają przeważnie również największej ilości polifenoli, które w wiodącej mierze odpowiadają za korzystny wpływ konsumpcji czekolady na funkcjonowanie organizmu człowieka. **Wnioski:** Należy zwracać większą uwagę na zawartość polifenoli w ciemnej czekoladzie niż na sam odsetek masy kakaowej, gdyż to one są bezpośrednio odpowiedzialne za właściwości korzystne dla zdrowia. Ponadto prezentowane dane pozwalają stwierdzić, że preferowanym rodzajem ciemnej czekolady powinna być ta zawierająca 80% masy kakaowej (lub przynajmniej 70%). Przy podejmowaniu odpowiednich decyzji może okazać się pomocna edukacja na temat żywienia od najmłodszych lat, gdyż kształtowanie odpowiednich nawyków żywieniowych w okresie dzieciństwa wpływa na schematy żywienia i odpowiednie wybory w dorosłym życiu.

Słowa kluczowe: czekolada, polifenole, zdrowa dieta, żywność funkcjonalna

INTRODUCTION

The topic of nutrition and the influence of certain types of food on individuals' health is constantly investigated and discussed. Unfortunately, the beneficial effects of some products have been widely approved with no deeper understanding or critical analysis of their content. This applies to chocolate, as its beneficial properties and positive health outcomes from regular intake are constantly reviewed⁽¹⁾. However, it must be noted that the generally used differentiation between types of chocolate (dark, milk, and white) does not provide enough information about their beneficial properties because of significant differences in the substances they contain, even within the same chocolate types⁽²⁾. What is more, many chocolates and their substitutes contain added sugar or saturated fats such as palm oil^(3,4). As a result, the positive aspects of chocolate consumption may be overshadowed by the detrimental effects of certain ingredients, underscoring the importance of a thorough analysis of chocolate composition. True dark chocolate should be composed of cocoa bean solids, which make up to 80% of the chocolate's total weight, and cocoa butter⁽⁵⁾. In contrast, milk chocolate has a considerably lower cocoa content (minimum 20–25%) with the addition of sugar, milk powder, and lecithin⁽⁵⁾. Furthermore, since white chocolate lacks cocoa solids⁽⁵⁾, along with milk chocolate and chocolate substitutes, it should not be considered when discussing the potential health benefits of chocolate. Instead, these products should be viewed as potentially harmful, given their high fat and sugar content^(6,7).

With the rise of obesity and pervasive sugar consumption, it is necessary to search for healthy options that may become an alternative to harmful sweets and, at the same time, positively influence health and physical performance. Therefore, this article aims to review the current state of knowledge on dark chocolate consumption and its nutritional value. It also seeks to investigate whether dark chocolate could be incorporated into a regular diet and regarded as a valuable food product. Demonstrating the positive impact of dark chocolate on human physiological functions may enhance awareness of the connection between proper nutritional education and bodily performance, potentially promoting more informed and health-conscious food choices.

MATERIALS AND METHODS

To select resources on the topic, the PubMed database was examined for relevant articles. Specific keywords such as “dark chocolate”, “health impact”, “cocoa products”, “polyphenols”, “phenolic compounds”, “types of chocolates”, and “cardiovascular diseases” were used in different combinations. Additionally, only articles published between 2010 and 2024 were considered.

As some of the articles appeared in several search results, after analysis, 28 distinct academic papers were selected. Certain criteria were taken into account including (1) relevance to the topic of the article and its subsections; (2) focus on the general population, as some of the sources pertained to specific groups of individuals only with rare diseases and conditions, following restrictive diets, or living in particular climate zones; (3) availability in English.

The decision to include specific studies in the article was made in consultation with all authors, thereby minimising the risk of potential bias.

RESULTS

The definition of dark chocolate

Although the term “dark chocolate” lacks a precise definition regarding cocoa content, it is commonly used to refer to chocolates with higher cocoa percentages. In the studies presented, both chocolates with 70% and 90% cocoa content are labelled as “dark chocolates”, which is quite misleading, as they differ in the concentration of compounds responsible for their health-positive outcomes⁽²⁾. Nevertheless, the presented studies assign the beneficial properties of chocolate consumption mainly to polyphenols, which comprise 10–15% of the dry weight of a whole cocoa bean^(5,8). Depending on the chemical structure, they can be divided into several groups – phenolic acids, flavonoids, stilbenes, lignans, and tannins⁽⁹⁾. Flavanols and flavonols, both belonging to the group of flavonoids together with catechins, anthocyanidins, and proanthocyanidins⁽⁵⁾, are present in dark chocolate in the highest quantities and are considered the most significant in terms of dark chocolate's beneficial properties^(9,10). What is more, cocoa is a rich source of minerals such as potassium, phosphorus, copper, zinc, and

magnesium⁽⁵⁾. A general trend has been observed, indicating that the levels of free phenolic compounds, flavonoids, and proanthocyanidins found in chocolate are strongly correlated with higher cocoa mass percentage, with a correlation coefficient (r) of approximately 0.9, which demonstrates a strong positive correlation⁽²⁾. This suggests that chocolates with higher cocoa percentages contain greater amounts of polyphenols; however certain studies highlight that polyphenol availability also depends on the origin of the cocoa beans and the manufacturing process applied. As a result, even chocolates with higher cocoa content may be poorer sources of polyphenols^(1,5). Accordingly, including polyphenol content values on chocolate packaging labels might be beneficial, as it could serve as a more accurate indicator of chocolate's beneficial properties than cocoa percentage alone.

Influence of dark chocolate on the cardiovascular system

Considering the impact of dark chocolate rich in polyphenols (DCRP) on the cardiovascular system, it is important to note that cocoa consumption is associated with a preventive role against cardiovascular diseases and may even contribute to heart protection^(11–20). This is particularly significant given that, according to the World Health Organization and Centers for Disease Control and Prevention, cardiovascular diseases are the leading causes of death and disability in the WHO European region⁽¹²⁾. To emphasise the positive influence on the cardiovascular system, Goya et al.⁽¹³⁾ cite the standpoint of the European Food Safety Authority (EFSA)⁽¹⁴⁾, which holds the opinion that cocoa flavanols promote endothelium-dependent vasodilation. These compounds are believed to activate nitric oxide (NO) synthase in endothelial cells, further resulting in an increase in cyclic guanosine monophosphate, which consequently activates the processes responsible for vasodilation^(1,15,16). Moreover, dark chocolate (90% cocoa) consumption might be recommended for individuals at risk of arterial and venous thrombosis due to its positive impact on platelet aggregation^(17,18). Another aspect worth consideration is the positive influence of cocoa consumption on cerebral flow⁽⁵⁾. A moderately inverse association between DCRP and stroke incidence was observed, although no quantitative data presenting a causal effect have been reported yet^(5,18).

As all of this facilitates the appropriate functioning of the cardiovascular system, the consumption of DCRP can be perceived as one of the means of preventing heart diseases and other cardiovascular conditions. As EFSA⁽¹⁴⁾ states, achieving the desired effects requires the daily consumption of 200 mg of cocoa flavanols, which can be delivered by administering less than 1 g of cocoa extract per day or through the ingestion of 10 g of high-flavanol dark chocolate⁽¹³⁾. Another study focusing on the beneficial properties of polyphenols in terms of mood and mental well-being suggested that advantageous effects can be observed after the consumption of 30 g per day of

high-cocoa (85%) dark chocolate⁽¹⁹⁾; this might suggest that different effects can be observed depending on the amount of chocolate consumed. Nevertheless, independently of the mentioned studies, the Academy of Nutrition and Dietetics suggests incorporating 400–600 mg of flavanols per day into the diet, indicating their ability to reduce the risk connected with cardiovascular diseases and diabetes⁽²⁰⁾. As shown, it is possible to deliver the preferred daily dose of flavanols by incorporating DCRP into an individual's regular diet, with no need for artificial supplementation.

Polyphenol intake and the gut–brain axis

As already mentioned, Shin et al.⁽¹⁹⁾ investigated the impact of the consumption of chocolate with 70% and 85% cocoa on individuals' emotional state and mood fluctuations. These were evaluated using Positive and Negative Affect Schedule (PANAS) test, a widely known and validated psychological assessment tool. It was observed that after 3 weeks of dark chocolate consumption, the group of individuals receiving the higher cocoa percentage chocolate noticed improvements in negative emotional states, which was not the case for those consuming 70% cocoa chocolate. This favours choosing chocolates with higher cocoa content, as they deliver greater amounts of beneficial substances – in 70% chocolate, it was stated to be 250 mg of polyphenols, and in 85% chocolate, it was 400 mg, which is around 1.5 times more⁽¹⁹⁾. Following on with the impact on mental health, studies have shown an inverse correlation between polyphenol intake and depressive symptoms^(21,22), proving that regular DCRP consumption can help manage both physical and mental health. Moreover, the same study highlights significant differences in the gut microbiota of individuals assigned to a control group consuming 70% cocoa chocolate and those who consumed 85% cocoa chocolate⁽¹⁹⁾. The difference results from the presence of specific gut bacteria responsible for transforming polyphenols into their active metabolites, which are believed to have neuroprotective properties⁽¹⁹⁾. As specific bacteria dominate polyphenol metabolic processes, their prevalence is favoured over others, illustrating the relationship between polyphenol intake and gut microbiota composition^(19,23). This also affects gut diversity and the gut–brain axis, which results in improved mood and lowered cortisol levels, contributing to a better psychological state⁽¹⁹⁾. Last but not least, the same study observed that gut microbiota diversity also plays a role in the protection against potential pathogens and certain diseases, such as inflammatory bowel disease; therefore, it is important in enhancing immunity and maintaining general well-being. Interestingly, the positive impact of 72% cocoa dark chocolate on well-being was demonstrated in another study, which involved chocolate intake for 28 days⁽²⁴⁾. It was observed that the consumption of dark chocolate led to decreased mental and physical fatigue, which was reflected in improved self-agency, social functioning, and increased grey matter volume⁽²⁴⁾. Moreover, a positive impact of dark chocolate consumption

on cognitive functions was demonstrated^(24,25), contributing to enhanced quality of functioning.

Role of dark chocolate in diabetes and obesity treatment

It is well established that individuals with diabetes or those at elevated risk, as well as those who are overweight, pay close attention to the nutritional quality of the foods and snacks they consume, with a particular focus on their health implications. Although this should apply to everyone, there is no doubt that individuals with the above-mentioned health problems are usually more aware of this fact. Due to their restricted dietary options, selecting foods that support rather than impair their health is particularly advantageous. Considering this, it should be emphasised that dark chocolate has been shown to inhibit adipogenesis, making it a viable snack choice for individuals with obesity⁽¹¹⁾. However, caloric balance should still be maintained, with food intake adjusted to the energy expenditure of an individual. Notably, a study assessing regular chocolate consumption reported no associated weight gain in participants⁽¹³⁾, which may not only support the beneficial properties of dark chocolate – particularly those associated with its positive influence on the satiety centre – but also shows that chocolate might be a healthy snack for people aiming to lose weight. This is consistent with the conclusions presented in another study, which observed that consumption of a dark-chocolate-based meal resulted in lower calorie intake compared to one which included milk chocolate instead⁽²⁶⁾. Therefore, incorporating dark chocolate into the diet may promote earlier satiety and better appetite control, potentially aiding in weight reduction or its maintenance. The positive impact of decreasing the amount of cholesterol receptors, which results in lowering LDL and total cholesterol levels, is also a significant advantage⁽²⁷⁾. At the same time, the authors mention that the consumption of dark chocolate does not affect HDL levels, which is a desirable and beneficial effect^(11,27). This favourable effect on body weight and lipid profile management may be particularly relevant for people with type 2 diabetes or those at risk, given that obesity plays a central role in the development of this disease. Additionally, DCRP consumption has been shown to enhance insulin sensitivity, contributing to improved glycaemic control both in individuals with and without diabetes^(28,29). Another important aspect in terms of glucose metabolism is that polyphenols stimulate GLP-1 release, which supports blood glucose stability and facilitates metabolic disease control as well as weight maintenance⁽³⁰⁾.

Dark chocolate and its potential for fortification

Apart from its beneficial properties, chocolate can also be appropriately modified and adjusted to meet patients' needs. It may serve as a medium for the delivery of

health-promoting substances to the body⁽³¹⁾. In one study, the authors created sugar-free milk chocolate enriched with prebiotics, omega-3 fish oils (eicosapentaenoic acid, docosahexaenoic acid), and sweeteners, some of which may exhibit prebiotic properties⁽³¹⁾. Since all of the aforementioned additional substances have been shown to positively influence performance by decreasing inflammation and improving glucose tolerance, DCRP appears to be a promising form of snack with a vast potential for modification and fortification, offering an innovative strategy for delivering beneficial substances to the body⁽¹¹⁾.

Dark chocolate consumption and individuals' food preferences

Although choosing higher cocoa content chocolate with a more bitter taste and incorporating it into a regular diet might be problematic for some individuals at first, it can gradually alter taste perception and affect their long-term food preferences. A study illustrating the impact of habitual food choices on taste perception found that individuals who consumed high-fat and high-sugar snacks for 8 weeks exhibited a shift in their food preferences towards less healthy foods than those they tended to consume regularly⁽³²⁾. Also, such changes in diet were proven to influence neuronal processes associated with the reward system, highlighting its impact on human behaviour and relationship with food⁽³²⁾. As the authors state – “changing the food environment and reducing the availability of energy-dense HF/HS [high-fat/high-sugar] food items is pivotal to combating the obesity pandemic”^(32, p. 580).

Considering the facts presented above, it can be stated that acquired knowledge, consciousness, and awareness of daily food choices and their impact on health play an essential role in the creation of healthy habits. This is key to supporting individual well-being and maintaining a healthy lifestyle. The incorporation of healthy habits and dietary practices early in life impacts the future choices of children who subsequently become adults and directly influences their approach to diet⁽³³⁾. That is why it is so important to educate individuals from an early age about proper food decisions and links between good nutrition and improved performance, which contributes to maintaining health and functioning more effectively.

DISCUSSION

Year by year, the promotion of an active and healthy lifestyle, which is believed to be key to general well-being and maintaining health, has been increasing. Certain principles have become widely recognised. As previously discussed, dark chocolate with a cocoa content of at least 70% is an excellent source of bioactive compounds which support longevity and health. Considering this fact, it is reasonable to state that DCRP is a very beneficial product that can be introduced to the regular diet thanks to its positive impact on

both physical and psychological health. While dark chocolate may initially be experienced as excessively bitter or intense, evidence reviewed earlier indicates that as individuals adapt to their diets, corresponding changes in their taste preferences tend to occur. However, this often requires time. Therefore, appropriate education and knowledge about the benefits of dark chocolate consumption may help overcome initial uncertainties and facilitate incorporating dark chocolate into the regular diet. As demonstrated, DCRP is a valuable functional food that can be incorporated into the daily diet in various forms, even when consumed alone as a snack, offering a promising alternative to conventional sugar-rich sweets commonly consumed by general population. It is important to emphasise the importance of choosing chocolate with a higher cocoa percentage, as its content predominantly correlates with higher quantities of polyphenols and other substances responsible for the positive impact of chocolate on health. Not only is dark chocolate believed to lower arterial blood pressure and improve endothelial functioning, but it also plays a vital role in the modulation of processes connected with glucose metabolism, leading to an increased insulin sensitivity and stabilisation of blood glucose levels. By diversifying gut microbiota, dark chocolate consumption may positively influence digestion and impact the gut–brain axis, resulting in improved mood and mental well-being. Considering the numerous beneficial properties of DCRP and the advantages of its regular intake, there is a strong rationale for encouraging patients to consume it every day. This also applies to children and teenagers who, when properly educated and aware, can develop healthy eating habits and patterns early in life – enabling them to make healthy food choices as they become adults. Such dietary intervention may help prevent the development of comorbidities and secondary diseases arising from poor dietary habits. In view of the above, it is reasonable to state that further investigation into the beneficial properties of DCRP is necessary. More comprehensive studies should be conducted to determine the optimal daily DCRP intake and to identify the types of DCRP that yield the most favourable outcomes. This might contribute to raising awareness of the importance of the polyphenol content in dark chocolate products, shifting the focus from cocoa percentage alone to a more nuanced understanding of their health-promoting potential.

CONCLUSION

In light of these considerations, informed consumers should opt for chocolates with a higher cocoa content, preferably 80% (or at least above 70%), with consideration also given to their polyphenol content. Incorporating such functional foods into the daily diet provides meaningful benefits for health and contributes to an overall nutritional quality, serving as an important component of a healthy lifestyle. Through such actions, people demonstrate awareness of the relationship between nutrition, health, and physical

performance, thereby taking active responsibility for their well-being. This leads to the conclusion that aligns with Jean Anthelme Brillat-Savarin's famous quote – “Tell me what you eat, and I will tell you who you are”. Though the writer lived in the 19th century, his thoughts remain relevant today, as the growing trend to maintain a healthy lifestyle and take care of proper nutrition reflects individuals' awareness and wisdom in the modern world.

Conflict of interest

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Author contribution

Original concept of study; collection, recording and/or compilation of data; analysis and interpretation of data; writing of manuscript: MM, ER, ACh, PJCh. Critical review of manuscript; final approval of manuscript: ER, ACh, PJCh.

References

1. Latham LS, Hensen ZK, Minor DS: Chocolate – guilty pleasure or healthy supplement? *J Clin Hypertens* (Greenwich) 2014; 16: 101–106.
2. Mikołajczak N, Tańska M: Relationships between cocoa mass percentage, surface color, free phenolic compounds content and antioxidant capacity of commercially available dark chocolate bars. *J Food Sci Technol* 2021; 58: 4245–4251.
3. Oliveira B, Falkenhain K, Little JP: Sugar-free dark chocolate consumption results in lower blood glucose in adults with diabetes. *Nutr Metab Insights* 2022; 15: 11786388221076962.
4. Ristić-Medić D, Petrović S, Polak T et al.: Trans fatty acids in frequently consumed products from Serbian and Slovenian market. *Cent Eur J Public Health* 2022; 30: 51–57.
5. Montagna MT, Diella G, Triggiano F et al.: Chocolate, “food of the gods”: history, science, and human health. *Int J Environ Res Public Health* 2019; 16: 4960.
6. Nagpal T, Sahu JK, Khare SK et al.: Trans fatty acids in food: a review on dietary intake, health impact, regulations and alternatives. *J Food Sci* 2021; 86: 5159–5174.
7. Ma X, Nan F, Liang H et al.: Excessive intake of sugar: an accomplice of inflammation. *Front Immunol* 2022; 13: 988481.
8. Tuenter E, Sakavitsi ME, Rivera-Mondragón A et al.: Ruby chocolate: a study of its phytochemical composition and quantitative comparison with dark, milk and white chocolate. *Food Chem* 2021; 343: 128446.
9. Halib H, Ismail A, Mohd Yusof BN et al.: Effects of cocoa polyphenols and dark chocolate on obese adults: a scoping review. *Nutrients* 2020; 12: 3695.
10. Martín MÁ, Goya L, Ramos S: Antidiabetic actions of cocoa flavanols. *Mol Nutr Food Res* 2016; 60: 1756–1769.
11. Samanta S, Sarkar T, Chakraborty R et al.: Dark chocolate: an overview of its biological activity, processing, and fortification approaches. *Curr Res Food Sci* 2022; 5: 1916–1943.
12. World Health Organization: Cardiovascular diseases (CVDs). 2024. Available from: [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)) [cited: 14 June 2025].

13. Goya L, Martín MÁ, Sarriá B et al.: Effect of cocoa and its flavonoids on biomarkers of inflammation: studies of cell culture, animals and humans. *Nutrients* 2016; 8: 212.
14. EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA): Scientific Opinion on the modification of the authorisation of a health claim related to cocoa flavanols and maintenance of normal endothelium-dependent vasodilation pursuant to Article 13 of Regulation (EC) No 1924/2006 following a request in accordance with Article 19 of Regulation (EC) No 1924/2006. *EFSA J* 2014; 12: 3654.
15. da Silva Medeiros N, Koslowsky Marder R et al.: Total phenolic content and antioxidant activity of different types of chocolate, milk, semisweet, dark, and soy, in cerebral cortex, hippocampus, and cerebellum of Wistar rats. *Biochem Res Int* 2015; 2015: 294659.
16. Arisi TOP, da Silva DS, Stein E et al.: Effects of cocoa consumption on cardiometabolic risk markers: protocol for a systematic review and meta-analysis of randomized controlled trials. *PLoS One* 2024; 19: e0309824.
17. Montagnana M, Danese E, Angelino D et al.: Dark chocolate modulates platelet function with a mechanism mediated by flavan-3-ol metabolites. *Medicine (Baltimore)* 2018; 97: e13432.
18. Yang J, Zhou J, Yang J et al.: Dark chocolate intake and cardiovascular diseases: a Mendelian randomization study. *Sci Rep* 2024; 14: 968.
19. Shin JH, Kim CS, Cha L et al.: Consumption of 85% cocoa dark chocolate improves mood in association with gut microbial changes in healthy adults: a randomized controlled trial. *J Nutr Biochem* 2022; 99: 108854.
20. Crowe-White KM, Evans LW, Kuhnle GGC et al.: Flavan-3-ols and cardiometabolic health: first ever dietary bioactive guideline. *Adv Nutr* 2022; 13: 2070–2083.
21. Godos J, Castellano S, Ray S et al.: Dietary polyphenol intake and depression: results from the Mediterranean healthy Eating, Lifestyle and Aging (MEAL) study. *Molecules* 2018; 23: 999.
22. Kontogianni MD, Vijayakumar A, Rooney C et al.: A high polyphenol diet improves psychological well-being: the Polyphenol Intervention Trial (PPhIT). *Nutrients* 2020; 12: 2445.
23. Martin FP, Montoliu I, Nagy K et al.: Specific dietary preferences are linked to differing gut microbial metabolic activity in response to dark chocolate intake. *J Proteome Res* 2012; 11: 6252–6263.
24. Nemoto K, Kokubun K, Ogata Y et al.: Dark chocolate intake may reduce fatigue and mediate cognitive function and gray matter volume in healthy middle-aged adults. *Behav Neurol* 2022; 2022: 6021811.
25. Sumiyoshi E, Matsuzaki K, Sugimoto N et al.: Sub-chronic consumption of dark chocolate enhances cognitive function and releases nerve growth factors: a parallel-group randomized trial. *Nutrients* 2019; 11: 2800.
26. Akyol A, Dasgin H, Ayaz A et al.: β -Glucan and dark chocolate: a randomized crossover study on short-term satiety and energy intake. *Nutrients* 2014; 6: 3863–3877.
27. Tokede OA, Gaziano JM, Djoussé L: Effects of cocoa products/dark chocolate on serum lipids: a meta-analysis. *Eur J Clin Nutr* 2011; 65: 879–886.
28. Shah SR, Alweis R, Najim NI et al.: Use of dark chocolate for diabetic patients: a review of the literature and current evidence. *J Community Hosp Intern Med Perspect* 2017; 7: 218–221.
29. Ramos S, Martín MA, Goya L: Effects of cocoa antioxidants in type 2 diabetes mellitus. *Antioxidants (Basel)* 2017; 6: 84.
30. Kawakami Y, Watanabe Y, Mazuka M et al.: Effect of cacao polyphenol-rich chocolate on postprandial glycemia, insulin, and incretin secretion in healthy participants. *Nutrition* 2021; 85: 111128.
31. Faccinotto-Beltrán P, Gómez-Fernández AR, Santacruz A et al.: Chocolate as carrier to deliver bioactive ingredients: current advances and future perspectives. *Foods* 2021; 10: 2065.
32. Edwin Thanarajah S, DiFeliceantonio AG, Albus K et al.: Habitual daily intake of a sweet and fatty snack modulates reward processing in humans. *Cell Metab* 2023; 35: 571–584.e6.
33. Mahmood L, Flores-Barrantes P, Moreno LA et al.: The influence of parental dietary behaviors and practices on children's eating habits. *Nutrients* 2021; 13: 1138.