# Cocoa and Chocolate, Antioxidant Actions and Neuro-Psycho-Emotional Protective Actions, a Short Review

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**Abstract:** Cocoa and chocolate is a subject of interest in daily lives of many people, but especially in recent years, and research topic due to their beneficial effects already proven on health. The aim of this paper is to present some information on cocoa and chocolate from the perspective of some of their antioxidant and neuro-psycho-emotional actions. The method is based on the structure of a mini narrative review. Cocoa and chocolate have been recognized as a rich source of flavonoids, mainly flavones, important for the beneficial effects on the body. Cocoa has also been found to have effects on the oxidative stress, lipidis, carbohydrates, neurocognition, mood, and behavior. Cocoa and chocolate have multiple beneficial effects, among them, the antioxidant, metabolic and neuro-psycho-emotional ones are very important.

**Keywords:** cocoa, chocolate, antioxidant actions, neuro-psycho-emotional actions

## 1. Introduction

Cocoa, tea, and coffee are actively investigated because they are rich in (poly) phenolic compounds that can modulate mental health, namely brain plasticity, behavior, mood, depression, and cognition (Visioli & Burgos-Ramos, 2016; Meyer et al., 2020). The flavonoid content of cocoa and chocolate products differs substantially depending on cocoa variety, geographic origin, cultivation,

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agricultural and postharvest practices, and manufacturing (Visioli et al., 2016). The concern for this theme was concretized in a postgraduate course intended for Romanian doctors (Jurcău, 2016).

## 2. Antioxidant Actions

Cocoa has been found to contain flavonoids and have an antioxidant capacity: 2 x red wine, 2-3 x green tea, 4-5 x black tea (Lee et al., 2003; Darwish et al., 2023). Chocolate also is an important daily source of antioxidants (Poliński et al., 2021).

*Effects on lipid peroxidation*

The antioxidants found in chocolate have been proven to inhibit the oxidation of plasma lipids (Bhagat et al., 2019). One study demonstrated that cocoa powder inhibits lipid peroxidation (Schinella et al., 2010), and another concluded that Procyanidin B2 and Procyanidin C1 (trimers) in cocoa inhibit lipid oxidation in liposomes (Verstraeten et al., 2005).

*Effects on the skin*

Cocoa polyphenols have a positive effect on skin tone and elasticity and suppress the toxicological effects of dioxins (Mukai et al., 2008). In topical preparations, cocoa polyphenols protect the skin from oxidative damage caused by ultraviolet radiation (Katz et al., 2011; Mogollon et al., 2014).

*Effects on lipid metabolism*

Cocoa consumption causes significant reduction in: total body weight, adipose tissue weight and serum triglyceride concentration (Matsui et al., 2005). After supplementing the diet with cocoa powder, there was: a) a decrease in LDLcp: by 15%, in young people with normocholesterolemia, after 14 days of the diet (Fraga et al., 2002); and by 5% in subjects with mild hypercholesterolemia after 4 weeks of dieting (Baba et al., 2007); and b) increase in HDLcp (Baba et al., 2007). Following consumption of flavonoids from different sources, a decrease in LDLcp occurred (Pal et al., 2003). In patients with essential hypertension, after the dark chocolate diet, LDLcp decreased by 11% (Fraga et al., 2002). Cocoa shell reduced adipocyte size, increased browning and high-density lipoprotein cholesterol (Braojos et al., 2023).

*Effects on carbohydrate metabolism*

Chocolate consumption in human subjects caused an acute increase in insulin secretion and insulin sensitivity (Hanhineva et al., 2010). Another study demonstrated that the greatest effects on insulin resistance were in acute and short-term chronic settings (Shrime et al., 2011). Different studies carried out by the same investigators have found that: administration of dark chocolate to healthy or hypertensive subjects causes a decrease in insulin resistance (Grassi et al., 2008).

Intake of cacao polyphenol-rich chocolate can manage postprandial glucose excursions, by enhancing early insulin and GLP-1 secretion in healthy participants (Kawakami et al., 2021).

## 3. Neuro-Psycho-Emotional Actions

*Effects on the nervous system*

Administration of a cocoa polyphenol extract delayed age-related brain impairments in rats. Cocoa consumption protects nerves from damage and inflammation (Katz et al., 2011). Cocoa flavanol conferres neuroprotective effect by improving cognition and mood during normoxia persists during severe oxygen deprivation (Bloomfield et al., 2023).

*Effects on chronic fatigue*

Subjects who consumed chocolate with cocoa liquor showed a reduction in symptoms of chronic fatigue syndrome (Sathyapalan et al., 2010). Cocoa flavanols Cocoa flavanols supplementation may delay fatigue by reducing exercise-induced oxidative stress (Corr et al., 2021).

*Effects on physical recovery*

Pre-exercise chocolate supplementation resulted in rapid recovery of post-exercise physiological and metabolic changes (Chen et al., 1996). Cocoa flavanol attenuated the increase in plasma cortisol induced by exhaustion and attenuates the alterations in systemic immunity induced by intensive training or exhausting exercise (Ruiz-Iglesias et al., 2022).

*Effects on learning, memory and cognition*

Supplementation with cocoa polyphenols causes immediate cognitive improvements (Scholey & Owen, 2013). Regular consumption of cocoa flavonoids can be effective in improving cognitive functions in the elderly with moderate memory impairment (Desideri et al., 2012). Habitual chocolate intake is linked to cognitive and memory performance (Crichton et al., 2016). Cocoa flavonoids would trigger the expression of neuromodulatory proteins in brain regions involved in learning, memory, and cognition (Sokolov et al., 2013), especially in the hippocampus (Sokolov et al., 2013). In addition, epicatechin is thought to reverse memory deficits and improve long-term memory formation (Knezevic et al., 2016). Also, young adults have better cognitive performance in learning, memory, and attention after daily consumption of cocoa (Shateri et al., 2023).

*Effects on mood*

Chocolate and cocoa activate cannabinoid receptors in the brain, leading to euphoria (Tomaso et al., 1996). Thus, consumption of cocoa flavones may be

beneficial for performance and mood during highly demanding cognitive processing (Scholey et al., 2010). High-dose cocoa significantly increases calmness and contentment (Pase et al., 2013). And chocolate appears to increase positive mood, especially when consumed mindfully (Meier et al., 2017). Eating in the morning at breakfast at the onset small amounts of chocolate, helps speed up resynchronization time and mood also (Garbarino et al., 2022). In middle-aged women, cacao flavanols may improve variable mood conditions and support their active lives (Murakami et al., 2023).

*Effects on anxiety and depression*

Chocolate intake is beneficial for depression, anxiety and irritability (Parker & Crawford, 2007). The administration of cocoa polyphenols leads to the improvement of symptoms of anxiety and depression (Pase et al., 2013). A study assessing the risk of depression among nursing women showed that chocolate consumption is not associated with a risk of depression (Lucas et al., 2011). Following the administration of cocoa polyphenols supplements/day, in affective disorders, depression symptoms decreased (Ibero-Baraibar et al., 2016). Additionally, an association was found between milk chocolate intake and lower anxiety levels (Martin et al., 2012). Also, cocoa-rich products have significant effect on depressive and anxiety symptoms (Fusar-Poli et al., 2022).

## 4. Conclusion

History, everyday life and the research done so far show that cocoa and chocolate have multiple beneficial effects. Among them, the antioxidant and neuro-psycho-emotional ones are very important. There are mechanisms that still need to be clarified. For this, additional studies are needed to elucidate the action of polyphenols in cocoa and chocolate.

### 4.1. Conflict of interests

Nothing to declare.

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