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DARK CHOCOLATE USE AS HEALTHY BAR

("DARK CHOCOLATE MEETS AMLA'')

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Abstract-

Vitamin C and other bioactive substances are present. Therefore, a snack bar made with amla powder and dark chocolate could potentially be a food that satisfies hunger while also promoting health. The flavonoids in dark chocolate, particularly catechins and procyanidins, are mainly responsible for its antioxidant, heart-protective, and mood-lifting effects. Furthermore, adding amla powder, a well-known natural source of vitamin C and other beneficial compounds, could enhance these benefits. Recent studies indicate that the synergistic effects of these two components may enhance nutritional benefits, improve shelf life through oxidative stability, and produce a unique sensory experience that is attractive to consumers prioritising health. Nevertheless, further standardised research is crucial to optimise formulation methods, evaluate the bioavailability of the combined phytochemicals, and determine the long-term health effects through clinical trials. Consequently, dark chocolate enriched with amla powder could represent a potentially advantageous functional food product, providing a practical and appealing approach to delivering natural antioxidants and fostering overall well-being.

Keywords: Dark Chocolate, Amla Powder, Antioxidant.

INTRODUCTION –

Chocolate is a food that has several uses, including as a sweetener, flavoring, and immune system booster. Chocolate can be consumed as a solid, liquid, or paste. Its primary use is as a flavoring in other foods. A basic chocolate would consist of a fat-continuous matrix with sugar, cocoa powder, and, in the case of milk chocolate, milk powder particles. Because it is present during the fat phase, cocoa butter stays constant regardless of the type of chocolate. Usually, the only fat present in dark or plain chocolates is cocoa butter. Additionally, chocolates contain an emulsifier of some sort that could be considered a part of the lipid phase of the chocolate. The two types of cocoa that are used in chocolate are cocoa butter and cocoa powder, which are a naturally occurring mixture. (Devos and others Five distinct chocolate masses—milk chocolate (MC), white chocolate (WC), ruby chocolate (RC), extra dark chocolate (EDC), and dark chocolate (DC)—were used in the research[1]. Cocoa is used to make every component of the EDC. Cocoa makes up 55.5%, 36.5%, and 28% of the DC, MC, and WC's constituent parts, respectively. Cocoa makes up 47.3% of the RC's constituent parts.. Compared to milk chocolate, dark chocolate contains either very little or no milk. Dark chocolate can be used in cooking or eaten on its own. It comes in thicker, baking bars with high cocoa percentages (usually between 70% and 99%)[2].

People often call dark chocolate "black chocolate." It is made by adding sugar and fat to cocoa. It is chocolate that doesn't have milk or has a lot less milk than regular chocolate. You can eat dark chocolate as is or use it in baking. People often sell baking bars that have a lot of cocoa in them (70% to 99%). Semisweet dark chocolate is different from bittersweet extremely dark chocolate. But the amount of cocoa butter to solids may be different. Chocolate has a lot of energy, protein, magnesium, calcium, iron, and riboflavin, all of which are good for the heart and brain. Cocoa seeds are high in copper, sulfur, and vitamin C. Flavonoids are naturally found in dark chocolate. Some people think that these substances can help lower blood pressure and fight high blood pressure heart disease, among other things.[3].The mineral nutrients found in cocoa beans, dark chocolate, and chocolates with different amounts of cocoa (60, 70, 80, and 90%) are compared. It has been proven that dark chocolates are a good source of iron (10.9 mg/100 g) and magnesium (252.2 mg/100 g). Their contents in chocolate with 90% cocoa are similar to 67.0% and 80.3% of the Nutrient Reference Values. 90% cocoa chocolate is a good source of selenium and zinc, which are both good for the immune system. Factor analysis looks at three main things that can help explain the mineral concentrations[4].

Dark chocolate is good for your health because it protects against heart attacks, some kinds of tumors, and other brain problems. Dark chocolate has properties that fight germs, reduce inflammation, and lower blood sugar levels. These properties help you stay healthy and live a good life. It also helps people lose weight and change their lipid profile, which is good for their health. But when you make dark chocolate, you lose some of the things that are in it, like polyphenol, flavonoids, flavan-3-ol, ascorbic acid, and thiamine. So, adding fortification would be a good way to get more nutrients and make the dark chocolate more self-sufficient[5].Eating dark chocolate in moderation is good for your health, but eating a lot of it is bad for your health. Dark chocolate does have a lot of sugar, fat, and calories, though. Eating too much dark chocolate raises the risk of heart disease, high blood pressure, weight gain, and insulin resistance, which can make health problems worse. Dark chocolate has a lot of flavonoids, which may change how the body and mind work. Researchers wanted to know how eating chocolate affected brain waves in the short and long term. Most brain areas had higher levels of Alpha and beta-amyloid protein and lower levels of Theta and delta amyloid protein after eating chocolate for a short time or a long time[6].
Stress is bad for mental health, but dark chocolate can help with memory. The study looked at how different diets high in dark chocolate affected different parts of the rats' brains when they were always under stress.[7] According to old Mayan texts, cultures before Columbus thought chocolate was a gift from the gods and used it as medicine. When chocolate was brought to Europe after America was found, Christians in Europe were very suspicious and didn't like it. Because of this response, doctors and scientists had to argue that chocolate was good for the body in order to get people to eat it. But during the Age of Enlightenment, the way to heal and the way to taste split, and chocolate was still a big part of medicine. But over time, it became connected to bad things like being overweight, having bad teeth, living an unhealthy life, and other issues. Chocolate has only recently come back to life, bringing back the value that Linnaeus gave to the generous plant Theobroma cacao, which he called "food of the gods[8]."

Fig. no. 1 Amla Powder

Importance of chocolate as nutraceutical:

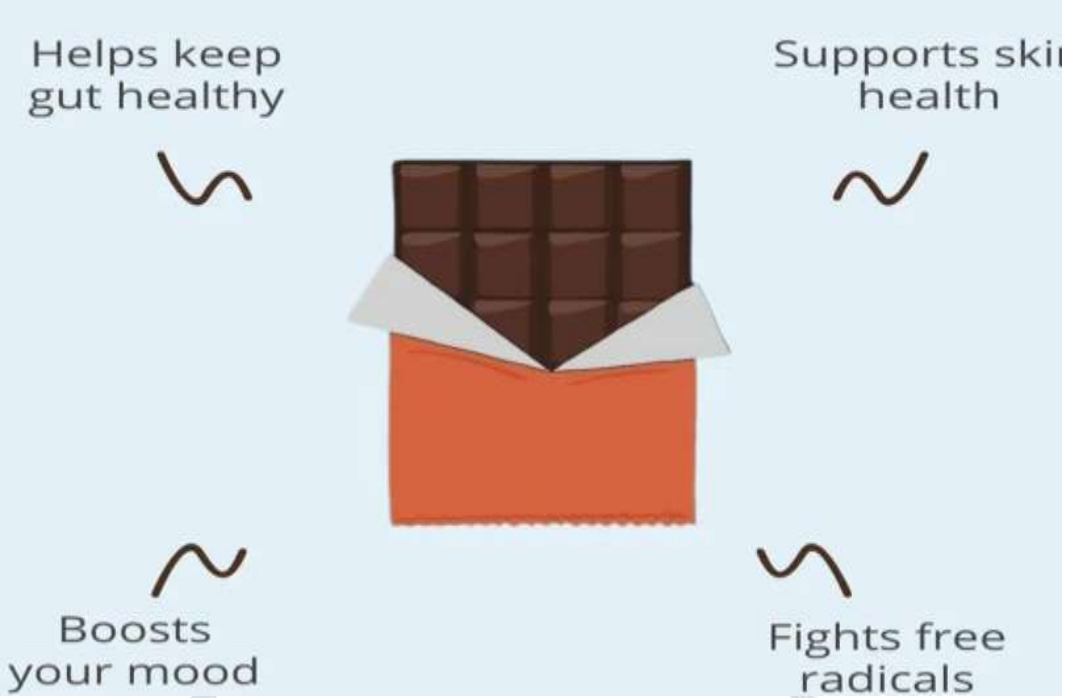

Fig. no. 2 Importance of dark chocolate

According to the United States Department of Agriculture Trusted Source, a 101-gram (g) bar of dark chocolate with 70–85% cocoa solids provides:

- 604 calories
- 7.87 g of protein
- 43.06 g of fat
- 46.36 g of carbohydrates
- 11.00 g of dietary fibre
- 24.23 g of sugar
- 12.02 milligrams (mg) of iron
- 230.00 mg of magnesium
- 3.34 mg of zinc

Dark Chocolate Benefits

The percentage of cocoa in chocolate tells you how much of the chocolate is made up of cacao. This means that a dark chocolate product with a higher cocoa content may have more of the nutrients that make it good for you. These beneficial compounds can include:

- flavanols
- polyphenols
- theobromine

The cocoa percentage on the chocolate is the amount of cacao that makes up all the other ingredients. That means that a dark chocolate product with more cocoa may have more of the nutrients that make it good for you.

- reducing free radicals
- improving blood flow
- lowering blood pressure

- lowering “bad cholesterol”
- reducing inflammation
- reducing insulin resistance
- improving the brain’s ability to make new connections between neurons
- increasing microbiome diversity[9].

Antioxidants:

Dark chocolate contains several compounds that possess antioxidant properties, such as flavanols and polyphenols. Antioxidants neutralize free radicals and prevent oxidative stress.

Oxidative stress refers to the damage that excessive amounts of free radicals can inflict on cells and tissues in the body.

Oxidative stress contributes to the natural aging process. Over time, the effects of oxidative stress may also contribute to the development of a variety of diseases, such as Trusted Source:

- heart disease
- diabetes
- Parkinson’s disease
- Alzheimer’s disease
- cancer
- eye disease

Heart disease risk:

Regularly eating dark chocolate may help reduce a person’s likelihood of developing heart disease. Some of the compounds in dark chocolate, specifically flavanols, affect two major risk factors for heart disease: high blood pressure and high cholesterol.

We discuss the potential benefits of dark chocolate for these two risk factors and others below:

Blood pressure:

The flavanols in dark chocolate stimulate nitric oxide production in the body. Nitric oxide causes blood vessels to dilate, or widen, which improves blood flow and lowers blood pressure.

A small 2015 study Trusted Source investigated the effects of chocolate consumption in 60 people with type 2 diabetes and high blood pressure. The researchers found that participants who ate 25 g of dark chocolate daily for 8 weeks had significantly lower blood pressure than those who ate the same quantity of white chocolate.

The findings of a 2017 review Trusted Source showed that the beneficial effects of dark chocolate on blood pressure might be more significant in older people and those with a higher risk of cardiovascular disease, as opposed to younger, healthy individuals.

Cholesterol:

Dark chocolate also contains certain compounds, such as polyphenols and theobromine, that may lower levels of low-density lipoprotein (LDL) cholesterol in the body and increase levels of high-density lipoprotein (HDL) cholesterol. Doctors often refer to LDL cholesterol as "bad cholesterol" and HDL cholesterol as "good cholesterol."

HDL cholesterol helps reduce the total amount of cholesterol in the blood while LDL cholesterol can narrow blood vessels.

According to a 2017 randomized, controlled study Trusted Source published in the *Journal of the American Heart Association*, adding almonds, dark chocolate, and cocoa to the typical American diet without exceeding caloric needs may reduce the risk of coronary heart disease. In combination, almonds and dark chocolate decreased the more damaging small, dense LDL particles in participants.

Anti-inflammatory effects:

Inflammation is part of the body's natural immune response to germs and other harmful substances. However, chronic inflammation can damage cells and tissues and may increase the risk of some health conditions, including type 2 diabetes, arthritis, and certain types of cancer.

Dark chocolate contains compounds with anti-inflammatory properties that may help reduce inflammation in the body.

A 2017 review of literature Trusted Source published in *Frontiers in Immunology* suggests that eating chocolate may influence the gut microbiome and encourage anti-inflammatory activity. Keep in mind that most of these gut studies were performed on animals, and more human studies are needed.

In a small study from 2018Trusted Source, researchers found that eating 30 g of 84% dark chocolate each day for 8 weeks significantly reduced inflammatory biomarkers in people with type 2 diabetes.

The authors of the study concluded that there is a need for additional studies to evaluate the optimal amounts of dark chocolate to use to treat those with diabetes.

Insulin resistance:

Insulin resistance occurs when the body's cells stop responding to the hormone insulin. Insulin resistance can cause abnormally high levels of blood glucose, which can lead to prediabetes and type 2 diabetes.

A 6-month study from 2018Trusted Source examined the relationship between regular dark chocolate consumption and blood glucose levels among Hispanic individuals. The research findings suggest that eating 48 g of 70% dark chocolate each day may help lower fasting glucose levels and reduce insulin resistance.

Brain function:

Eating dark chocolate may improve brain function and help prevent neurodegenerative conditions, such as Alzheimer's disease and Parkinson's disease.

The findings of a small 2018 study Trusted Source suggest that the flavanols present in dark chocolate may enhance neuroplasticity, which is the brain's ability to reorganize itself, particularly in response to injury and disease.

A study from 2016 identified a positive association between regular chocolate consumption and cognitive performance. However, the researchers collected data from surveys and had to rely on self-reported chocolate intake, so they were unable to draw any definitive conclusions from the findings.

Microbiome diversity:

Eating dark chocolate may benefit the gut microbiome, which can aid digestion.

A 2022 South Korean study published in *The Journal of Nutritional Biochemistry* found that eating dark chocolate was associated with increases in the diversity of the gut microbiome.

The results of their research also suggested that eating 85% dark chocolate may have a positive correlation with mood. The researchers attributed this benefit to the increased diversity of the microbiome, which can affect mood through the gut-brain axis.

Risks and considerations:

The health benefits of dark chocolate come primarily from the flavanols present in the cacao solids.

However, flavanol content varies among dark chocolate products. Processing methods also differ between manufacturers, and this can affect the flavanol content of the chocolate.

There is no legal requirement for chocolate manufacturers to report the flavanol content in their products. However, dark chocolate products with a higher percentage of cacao solids should generally contain more flavanols.

Although dark chocolate contains beneficial antioxidants and minerals, it is usually also high in sugar and fat, which makes it a very calorie-dense food.

Dark chocolate contains fat in the form of cocoa butter, which mainly consists of unhealthful saturated fats.

People should, therefore, try to limit their consumption of dark chocolate to avoid consuming too many calories, fats, and sugars.

In general, dark chocolate contains less sugar than milk chocolate and white chocolate. Dark chocolate with higher percentages of cacao solids typically contains even less sugar. Sugar content varies among chocolate manufacturers, so it is advisable to check the nutrition label.

A recent article in Consumer Reports tested several popular dark chocolate products and found that many contain high levels of lead and cadmium. Since these substances occur naturally in cacao, removing them has been a challenge for chocolate manufacturers.

The report found that some of the safest dark chocolate in 2022 came from Ghirardelli, Mast, Taza, and Valrhona.(Medically reviewed by Sade Meeks, MS, RD — Written by Jamie Eske — Updated on October 25, 2023)

Introduction to amla (Indian gooseberry)

Nutritional Composition of Amla:

Amla fruits are a good source of carbohydrates, with more than 70 grams per 100 grams of dry weight (DW). Fiber is another important part, along with protein, minerals like iron, calcium, and phosphorus, and fat (2.0–4.5, 2.1–3.1, and 0.2–0.6 g/100 g DW, respectively). Many studies have said that the different types of amla fruit have different compositions[10].

Variety	Moisture	Carbohydrate	Fiber	Minerals	Protein	Fat	Vitamin C	Ref.
Local variety (no name)	81 g/100 g	14 g/100 g	3.2 g/100 g	0.3 g/100 g	1 g/100 g	0.5 g/100 g	720 mg/100 g	[11]
Local variety (no name)	82.8 g/100 g	7.6 g/100 g	5.1 g/100 g	2.3 g/100 g	2.0 g/100 g	0.3 g/100 g	573 mg/100 g	[12]
NA-7 NA-9 NA-10 Balwant Chakaiya Hathijhool	84.9–87.5 g/100 g	77.2–81.9 g/100 g DW	11.7–16.0 g/100 g DW	2.1–3.0 g/100 g DW	3.0–4.5 g/100 g DW	0.2–0.5 g/100 g DW	489.9–585.0 mg/100 g	[13]
NA-7, Banarasi, Kanchan, Chakaiya and Desi	81.3–84.6 g/100 g	73.8–87.1 g/100 g DW	7.2–22.4 g/100 g DW	2.2 to 3.1 g/100 g DW	2.0 to 3.2 g/100 g DW	0.4–0.5 g/100 g DW	193–315 mg/100 g	[14]
Krishna, Kanchan, NA-7, Chakaiya	85.6–87.7 g/100 g	70.7–73.8 g/100 g DW	13.9–16.5 g/100 g DW	2.3–2.8 g/100 g DW	2.9–3.6 g/100 g DW	0.5–0.6 g/100 g DW	421–506 mg/100 g	[15]

Table no. 1 Nutritional Constituent of Amla

Vitamin C, also known as ascorbic acid, is another important part of amla fruit. Different studies that looked at different types of amla have found values between 193 and 720 mg/100 g. Amla fruits also have vitamins A, B1, and E (290 IU, 30 mg/100 g, and 0.17 mg/100 g), as well as calcium and iron (25 and 1 mg/100 g).[11-14].The Recommended Dietary Allowance (RDA) for vitamin C, which is the minimum amount a healthy person needs to get in a day, is between 40 and 110 mg. This is because new factors in modern society have made it hard to figure out what the best amount is[16]. Also, the health authorities in Australia and China have suggested that people take in 190–220 mg/day. For this reason, a serving of at least 100 g of fresh amla fruits (2–3 pieces) from any of the varieties listed in Table 1 should be enough to meet the daily need for vitamin C. P. emblica L. juice can have more vitamin C than other fruits like apples, limes, pomegranates, and some types of grapes[17, 18].

Phytoconstituents of Amla

Researchers have found that amla has a lot of phytochemistry in different parts of the plant, like the fruits, leaves, and roots. Polyphenols (Figure 1) constitute the principal category of secondary metabolites, encompassing various compounds such as phenolic acids, flavonoids, tannins, other phenolics, and their derivatives, as documented in numerous studies.

Figure-Phytochemicals found in amla[19].

The phenolic acids found in fresh fruit and commercial products made from the fruit included hydroxybenzoic acids (4-hydroxybenzoic acid, coumaric acid, gallic acid, protocatechuic acid, syringic acid, and vanillic acid). The fresh fruits and fruit-based products that were tested for flavones showed that they contained apigenin, luteolin, and myricetin. The only hydroxybenzoic acid found in leaves and branches is gallic acid. The presence

of hydroxycinnamic acids (caffeic acid and chlorogenic acid) was exclusively identified in amla fruits[20-24]. Flavonoids, especially flavonols, flavones, flavanones, and flavan-3-ols, are another type of chemical that has been found in the amla plant. There are a lot of flavonols in different parts of the amla plant. Kampferol and its derivatives (dihydrokaempferol, kaempferol 3-b-dglucopyranoside, kaempferol 3-o-rhamnoside, kaempferol-3-o-α-l-(6″-ethyl)-rhamnopyranoside, and kaempferol-3-o-α-l-(6″-methyl)-rhamnopyranoside) can be found in fruits, leaves, branches, and shoots. Like this, quercetin and its derivatives (quercetin 3-b-D-glucopyranoside, quercetin 3-O-glucoside, quercetin 3-O-rhamnoside, and rutin) are found in fruits, leaves, and branches. It was said that myricetin 3-O-rhamnoside was only found in the leaves and branches of the amla tree. Flavanones and flavan-3-ols were only found in leaves and branches, which is interesting. The identified flavanones include eriodictyol, naringenin, and their derivatives: (S)-eriodictyol 7-O-(6″-O-galloyl)-β-D-glucopyranoside, (S)-eriodictyol 7-O-(6″-O-trans-p-coumaroyl)-β-D-glucopyranoside, naringenin 7-O-(6″-O-galloyl)-glucoside, naringenin 7-O-(6″-O-trans-p-coumaroyl)-glucoside, and naringenin 7-O-glucoside. For flavan-3-ols, the compounds found were epicagallocatechin, epigallocatechin 3-O-gallate, and gallocatechin. Another important group of phenolic compounds found in amla fruits, leaves, and branches is tannins. Many studies show that ellagitannins are present. These include chebulinic acid, chebulagic acid, corilagin, emblicanin A and B, geraniin, isocorilagin, pedunculagin, phyllanemblinins A–F, and punigluconin[25-28].

[In fruits, leaves, and branches, ellagic acid and its derivatives (decarboxyellagic acid and 3′-O-methylellagic acid 4-O-α-L-rhamnopyranoside) were also found. Hydrolysable tannins (1,2,3,4,6-penta-O-galloyl-β-D-glucose, 1,2,3,6-tetra-O-galloyl-β-D-glucose, and 1,2,4,6-tetra-O-galloyl-β-D-glucose) and phlorotannins (2-(2-methylbutyryl)phloroglucinol 1-O-(6″-O-β-D-apiofuranosyl)-β-D-glucopyranoside) are mostly found in the leaves and branches of amla. Tannic acid is the only one that was found in amla fruit. Additionally, other phenolics, specifically 2,4-di-tert-butylphenol and Phenol, 3,5-bis(1,1-dimethylethyl), were also reported in amla fruit. Amla was also found to contain alkaloids, especially phyllantine and phyllantidine[24, 29].

Conclusion:

The escalating consumer interest in functional and nutraceutical foods has spurred the exploration of novel ingredients to enhance the nutritional and therapeutic attributes of traditional confections. Dark chocolate, renowned for its high flavonoid, catechin, and polyphenolic content, has been the subject of considerable investigation due to its antioxidant, cardioprotective, and mood-enhancing effects. Amla (Emblica officinalis), a fruit indigenous to India, is highly valued in Ayurvedic practices for its substantial vitamin C content, potent antioxidant capabilities, and diverse array of bioactive phytochemicals, such as tannins, gallic acid, and ellagic acid. Consequently, a potential strategy for developing a synergistic functional food, which would integrate the benefits of cocoa polyphenols and amla phytoconstituents, involves the incorporation of amla powder into dark chocolate formulations. This study comprehensively investigates the potential of amla-fortified dark chocolate as a functional food, focussing on its nutritional, physicochemical, sensory, and health-related characteristics. It highlights how amla's constituents might enhance the bioavailability of phenolic compounds within chocolate, influence lipid oxidation processes, and bolster antioxidant stability. Furthermore, the paper addresses technological considerations, including particle size optimisation, microencapsulation techniques, and the incorporation of natural sweeteners to preserve taste, alongside formulation challenges such as bitterness, astringency, and textural alterations resulting from amla incorporation. Recent studies suggest that incorporating amla into dark chocolate, in the correct proportions, boost its antioxidant properties and extends its shelf life. This also aligns with consumer preferences for plant-based, clean-label, and health-focused products. Consequently, the fusion of dark chocolate and amla powder presents a novel and sustainable approach to developing functional foods. It marries age-old knowledge with modern food technology, resulting in a product designed to support well-being and preventative nutrition.

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Author's Contribution:

Sanjivani Mahale: Conceptualization, Methodology, Investigation, writing Original draft preparation, Visualization.

Mansi Jadhav: Conceptualization, Methodology, Investigation, writing Original draft preparation, Visualization.

Prajkta Kate: Conceptualization, Supervision.

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Competing interests

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