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Preparation of Hand-Made Chocolates and the Nutritional Composition of its Ingredients

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ABSTRACT: Chocolate is an incredibly stable substance that, under normal circumstances, will last forever. The physical-chemical characteristics of chocolate made from native cocoa beans were compared to those of commercial chocolate, and the physical-chemical characteristics of cocoa beans were investigated after fermentation, drying, roasting and grinding. We looked at the sample nibs' moisture, ash, fat, fiber, protein and tannin content. India's chocolate sector has made significant progress. India is home to numerous cocoa producers that provide a wide range of industrial and domestically produced chocolate-based goods. For the purpose of producing chocolate, cocoa beans are used to make cocoa powder and its byproducts. Therefore, their disposal could cause problems with the environment and the economy. For novel and useful dishes, cocoa powder may be a valuable component or additive. In the context of a circular economy, the value-adding of food byproducts is more important. A source of fiber (around 50% w/w), proteins, minerals, vitamins, and a wide variety of polyphenols., cocoa beans are also a possible supply. The purpose of this review is to examine the chemical and nutritive makeup of cocoa bean powder used in the production of chocolates and to re-evaluate the numerous uses that have been suggested in order to maximize the value of this byproduct for use in food, livestock feed, industrial applications, as well as critical care medicine. Studies reporting the bio-functional potential of cocoa powder for human health, such as antibacterial, antiviral, anti-carcinogenic, anti-diabetic, or neuroprotective activity, benefits for the cardiovascular system, or an anti-inflammatory capability, will receive particular attention.

Keywords: Chocolates, Cocoa by-product, Human health bioactivity, Flavonoids.

INTRODUCTION

Cocoa beans are the foundation of chocolate and related products. The cocoa bean, the plant's seed, is grown in tropical regions (Agus *et al.*, 2018). In the first edition of "Species Plantarum," which was published in 1753, the Swedish scientist Linnaeus gave the name "Theorem Cocoa." It belongs to the Sterculiaceae genus of plants (Diomande *et al.*, 2015). Botanically, there are two major groups: the white seeded Criollo, which is less common but produces high-quality cocoa with a mild flavor, and the purple seeded Forester, which provides the majority of the world's chocolate (Agus *et al.*, 2018). The seeds, or cocoa beans, of the obroma cocoa trees, which are indigenous to South and Central America, are used to make both cocoa and chocolate. After being separated from the pods, the bean must undergo microbiologic and enzymatic fermentation in order to remove the pulp or mucilage coating and to enhance flavor (Badrie *et al.*, 2015). Cocoa beans are dried to lower the moisture content to an acceptable level for storage and shipping without compromising bean quality. The beans must be dried at a temperature between 45 and 60 degrees Celsius. To offer the beans a good keeping quality, they are machine- or sun-dried to a moisture content of around 7% (Diomande *et al.*, 2015). Roasting dried cocoa beans releases the bitter volatile compounds while enhancing the distinctive flavor and scent of chocolate. The shell is loosened while the nib is dry. Then, using a grinder, the powdered roasted nibs were produced (Diomande *et al.*, 2015). To make dark "eating (solid)" chocolate, sugar and ground, roasted beans were combined with cocoa butter. Cocoa in the milk. Around 1876 Swiss scientists

created a recipe that included dried milk solids. In order to make chocolate and chocolate-related items, cocoa butter and cocoa powder are required (Aleksander Całkosiński *et al.*, 2019). The amounts of sugar, milk, cocoa butter, and other ingredients vary across the many forms of chocolate (Kim and Keeney 1983). This article is the result of promoting the research methodology and employability skills among the undergraduate students.

MATERIALS AND METHODS

Materials. Indigenous cocoa beans (the purple seeded Forastero) were collected from Cocoa Bean Connections, GM Palya, C V Raman Nagar, Bengaluru, Karnataka 560075, India, were prepared for cocoa powder in laboratory by fermentation, drying, roasting and grinding. Sugar, commercial milk fat, milk powder were purchased from a local supermarket.

Methods

Fermentation of Cocoa Beans. The freshly harvested cocoa pods were stored for ten days under shady place and fermented for five days with single turning after 48 hours. Cocoa beans were prepared from various fermentation times. Cocoa beans fermented for 2-8 days.

Drying of Fermented cocoa Beans. The fermented cocoa beans were dehydrated/ dried by two drying methods: sun-drying, artificial drying (dryer). The purpose of drying operation was to determine the characteristics of cocoa beans related to moisture content, drying rate under various condition (sun-drying and dryer). The drying rates of fully fermented cocoa beans for different methods.

Roasting of Fermented, Dried cocoa Beans. A pan that is directly heated and stirred was used for roasting. To separate the shell and nib by employing a fan, the brittle roasted beans were fractured into pieces and blown with air. Roasted nibs' moisture, ash, fat, protein, crude fiber and tannin contents were identified and the pertinent data is presented.

Preparation of Cocoa Powder. Roasted nibs were pulverized in a grinder to a very fine powder. Using 140 mesh and 200 mesh screens, the ground-up mixture was sorted. The cocoa powder samples were made, that is, they were under fermented. Organoleptic tests were used to examine the sensory evaluation of cocoa powder, and the findings are displayed.

Preparation of Milk Chocolate. The ingredients used to make milk chocolate were 10 g of fully fermented cocoa powder, 30 g of sugar, 15 g of milk powder, and 15 g of milk fat. In the pan, crystal sugar and cocoa powder were combined and ground. A homogenous paste was created by combining the mixture from the grinder with milk powder and milk fat (a substitute for cocoa butter). The paste was decreased in size by running it through the refining rolls, where it is crushed to give a smooth texture, as the mixture may contain fairly coarse particles. The next process was to conch or kneads the chocolate in a mixing bowl to give it more taste, smoothness, and viscosity. For three hours, conching was carried out at roughly 60°C (Gutiérrez-Ríos *et al.*, 2022). Conching is not required for the production of chocolate, but it is rarely skipped when creating a product of superior quality. When tempering chocolate by hand, one-third of the chocolate was spread out on a cold surface to cool from a temperature of roughly 60 °C. After being scraped off, the solidified chocolate was combined with the remaining liquid chocolate. The chocolate's final temperature was kept under control at 32°C. The following is a straightforward approach to calculate chocolate tempering. The chocolate, which was hopefully temperate, was applied to a metal spatula (or knife blade), leaving only a thin film behind. The spatula was then placed in a cool environment (18 to 21°C). The period of time needed for the chocolate to become touchable firm was noted (Set-up timing).

Various activities in laboratory for making of chocolates

Coca beans grinding

Equipments setup

Molding and coating were the procedures used to create final chocolate. The chocolate is cooled from its liquid state until it solidifies in order to be molded. Each batch yielded 50 g of chocolate after molding. For additional studies, the chocolate was stored in the freezer at a temperature of 18°C. The physico-chemical

characteristics of chocolate and other foreign chocolate were identified. Organoleptic tests were used to evaluate the flavor and smoothness of chocolate, and the findings are displayed along with a comparison to imported chocolate.

RESULTS AND DISCUSSION

Before making cocoa powder, it's needed to perform the steps of fermentation, drying, roasting, and pod storage. The findings indicated that under-fermented dry **cocoa** beans ranged between these two extremes and had a dense, cheesy texture and colour. Over-fermented **cocoa** beans (fermented for more than 10 days) produced flavourless chocolate, whereas fully fermented **cocoa** beans (fermented for 5 to 10 days) were brown and friable with voids between the cotyledons (Ravindran and Jaiswal 2016).

The findings indicated that fermented cocoa beans dried quickly in the dryer. However, there were not many differences in the quality of the products between sun drying at 40°C and continual drying at 45°C. Additionally, it was discovered that continual drying reduced moisture level to 7% whereas natural solar drying during the rainy season reduced moisture content to 8%. The results of the comparison demonstrated that drying with a drier was in accordance with Dimick (1993), who discovered that dried **cocoa** beans with a moisture level of 7% had good keeping quality (Pérez *et al.*, 2015).

Table 1: Nutritional composition of cocoa bean powder.

Parameter	Moles	**Amount**
Energy	(kcal/100 g)	122.00
Moisture	(%)	3.60–13.13
Ash	(g/100 g)	5.96–11.42
Proteins	(g/100 g)	10.30–27.40
Fats	(g/100 g)	1.50–8.49
Carbohydrates	(g/100 g)	7.85–70.25
Starch	(g/100 g)	0–2.80
Soluble sugars	(g/100 g)	0.16–1.66
Dietary fiber	(g/100 g)	39.25–66.33
Soluble fiber	(g/100 g)	7.03–16.91
Insoluble fiber	(g/100 g)	28.34–50.42
Pectin	(g/100 g)	7.62–15.59
Minerals		
Calcium	(g/100 g)	0.23–0.44
Phosphorus	(g/100 g)	0.58–1.00
Magnesium	(g/100 g)	0.48–1.29
Potassium	(g/100 g)	1.25–1.82
Sodium	(mg/100 g)	16.00–192.20
Iron	(mg/100 g)	27.60–80.50
Manganese	(mg/100 g)	4.53
Copper	(mg/100 g)	2.35–6.62
Selenium	(mg/100 g)	0.21
Cobalt	(mg/100 g)	0.10
Zinc	(mg/100 g)	2.75–19.00
Chromium	(mg/100 g)	0.67-4.86
Vitamins		
B1	(µg/g)	0.70–3.10
B2	(µg/g)	0.90–3.10
B6	(µg/g)	Tr
D	(µg/g)	tr–0.53
E	(µg total tocopherols/g CBS fat)	1.02

To produce the flavor molecules that result from the precursors created during the fermentation and drying of **cocoa** beans, roasting is necessary. The early chemical properties of the roasted ground nibs were compared to those that have literary significance. The findings of the analysis of the roasted ground nibs for moisture, ash, fat, fiber, protein and tannins were presented (Panak Balenti *et al.*, 2018). The amount of moisture, ash, fat, protein, fiber and tannins was found to be comparable to values in the literature. Due to the acetic acid created during fermentation, which adds a harsh flavor and taste, the results in the sample gave birth to a harsh astringent flavor, masking the chocolate flavor in the final manufactured items. The Samples concurred with the findings of Kennedy, 1983, who discovered that a darker, redder cocoa product is linked to a more chocolate-like flavor. Excessively fermented cocoa powder a different technique revealed that the chemical content of imported and homemade chocolate was essentially the same (Kowalska *et al.*, 2017). Additives, nuts like walnuts, hazelnuts, and almonds, as well as raisins and other dried or candied fruit, might alter these values. For the preparation of chocolate, tempering is a crucial step. Organoleptic tests were used to determine the samples of chocolate (both laboratory-made and other imported chocolate). A

comparison between the sample and other imported chocolate samples is shown in some values. The completed products of both imported and handcrafted chocolate should be lustrous, hard, glossy, as this is a sign that the chocolate has been properly tempered. However, hand-made chocolate did not come in a smooth form. It can be seen that the particle size of the chocolate plays a major role in whether it has a gummy, creamy, or gritty texture. The best way to determine how smooth a chocolate bar is is to taste it, but this method has apparent limitations, so it is more common to measure the chocolate bar's particle size instead (Thangaraj, 2016).

It is crucial to grind the roasted beans into a fine pulp because this is the first step in creating a product that is incredibly smooth. According to Jensen, a small percentage of cocoa particles larger than 100 micrometres in diameter may create the appearance of roughness. The paste is crushed into flakes that are substantially smaller than usual using a set of rollers in commercial chocolate refineries. This process is crucial in determining how smoothly chocolate will go down when consumed. In this study, just a hand-operated equipment was employed to grind the roasted **cocoa** beans and refine the chocolate. A screen with an opening of 0.105mm (105 micro metres) was utilised, indicating that the particle size of the cocoa powder was 0.105mm (105 micro meters). Roughness was perceived at diameters greater than 100 micrometres (Thangaraj, 2016).

There were no noticeable differences in the chocolate samples' colour or flavor. However, because it is challenging to extract cocoa butter from the cocoa powder obtained from our research, chocolate sample perception gritty mouth sensation due to the particle size of cocoa powder it include. Modern techniques make use of rollers, vertical discs or a mix of the two. The process causes the fat cells to burst and the frictional heat causes the mass to liquefy. A hydraulic press can be used to turn the resulting liquid or cocoa mass into cocoa powder. It can also be sealed off for storage (Badrie *et al.*, 2015). According to the nutritional value of cocoa powder and chocolate, cocoa powder made from the processes employed in our research might be utilized as a raw ingredient in place of imported cocoa powder when creating chocolate.

With a focus on the areas that have received little attention thus far, such as the effect of cocoa in immunological modulation, inflammation, neuroprotection, oxidative stress, obesity, and diabetes control, numerous studies now describe current advancements on potential health advantages of cocoa. This interpretation of recent studies on the health advantages of eating chocolate has as its focus (Aleksander Całkosiński *et al.*, 2019).

Health benefits of Chocolate. Numerous antioxidants are found in cocoa beans. These antioxidants can lessen cell oxidation in your body, reducing the risk of cancer, heart disease, and disorders like Alzheimer's. Cocoa beans' fiber helps to support normal digestion. Getting adequate fiber might ease digestive problems like hemorrhoids and soften our bowel motions (Madhavadas *et al.*, 2016). Compared to red wine, cocoa has more heart-healthy Flavonoids. Better heart health has been associated with certain Flavonoids. Healthy fats and other substances found in cocoa beans have been shown to raise serotonin and dopamine levels in the brain, which have an effect on mood.

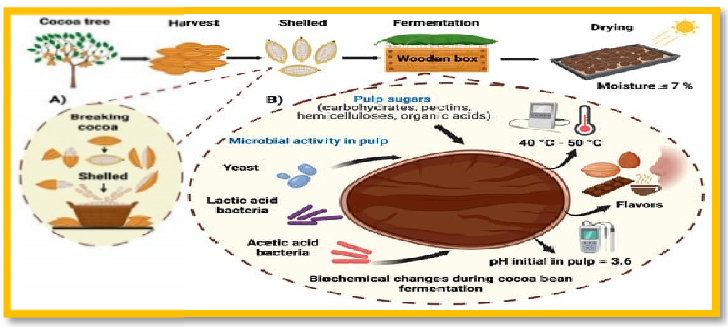

Fig. 1. (Gutiérrez-Ríos *et al.*, 2022**)**

The consumption of dark chocolate, a product of the cocoa bean, may raise "good" HDL cholesterol, which can help reduce your risk of heart attack and stroke (Magrone *et al.*, 2017). Dark chocolate, which is made from the cocoa bean, may increase “good” HDL cholesterol, which can help lower your risk of heart attack and stroke. Because they serve to lessen the stress on human cells and lower blood pressure, Flavonoids and potassium found in cocoa beans may reduce our chance of developing heart disease (Maki *et al.*, 2001). The anti-inflammatory characteristics of several molecules found in cocoa beans may help to lower the risk of developing cancer, heart disease, diabetes, arthritis, and depression.

Chocolate market - Future scope in India. The current study is focused on our students' abilities to develop their knowledge and self-employment skills and produce anything they want to introduce to society. This study presents a thorough examination of the chocolate market, taking into consideration all relevant elements (Nur Suhaili Ramli (2017). This includes a wide range of information, from a macro-level market assessment to particular data about how the sector performed, as well as current trends, key market drivers and obstacles, value chain analysis, and more (Nur Suhaili Ramli (2017). This paper is essential reading for chocolate manufacturers, investors, researchers,

consultants, and business strategists who are interested in or want to enter the market. In 2022, the chocolate market in India had a value of $2.4 billon. The market is anticipated to develop at compound annual growth rate (CAGR) of 8.8% from 2023 to 2028, according to major projects in India (Margherita Del and Antonella 2020).

CONCLUSION

Even though a finished chocolate product that was glossy, firm and polished was obtained, it appeared rough. This result suggested that additional research has to be done to obtain the smoothness of chocolate by reducing the particle size of cocoa powder using a set of rollers (contemporary refiners). High quality chocolates with 90% of the particles smaller than 20 micrometers can be produced by modern refiners.

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Conflict of Interest. None.

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