The Possibility of Benefiting from Date Seed Powder in The Manufacture of Chocolate Spread and Studying Its Quality Characteristics

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Abstract

This research aimed to study the possibility of benefiting from date seed powder as a healthy substitute for cocoa powder in chocolate processing, by determining some chemical indicators of cocoa powder and date seed powder and studying the effect of replacing cocoa powder with date stone powder in different proportions in the content of total phenol, antioxidant activity and color indicators, and sensory properties of chocolate compared to the control. The cocoa powder sample showed a significant increase in moisture content and pH compared to the date seed powder sample. The date seed powder sample was characterized by higher fiber content (79.31%) on a dry weight basis than cocoa powder. Chocolate samples manufactured using 100% date seed powder showed a significant increase in ash and raw fiber content and a substantial decrease in moisture content, pH number, and total sugar content compared to the control sample. The addition of date seed powder led to a significant increase in the content of total phenol and antioxidant activity in the sample (100% date seed powder), a moral increase in the value of (L* and h) indicators, and a significant decrease in the (a*, b* and C)values compared with the other studied samples. The chocolate sample manufactured using 4% date seed powder was significantly superior in the degree of taste, aroma, and texture compared to the rest of the studied samples, while the control sample was significantly superior in color terms.

Key Words: Chocolate Spread, Cocoa Powder, Date Seed Powder, Chemical Indicators, Total Phenols, Antioxidant Activity, Sensory Properties.

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1- Introduction:

The cocoa crop (*Theobroma cacao*, L.) is considered one of the world's most important agricultural exports, and its origins in Central and South America and West Africa, with a global production of 4697 thousand tons in 2019-2020 [30]. Cocoa beans are a major component of chocolate production [17], and are popular with people of all ages. Beside fats, they are rich in proteins, carbohydrates, and bioactive compounds, including phenols [8].

Chocolate is a sweet-tasting product commonly consumed with bread, pies, biscuit, and other spread foods. It should not solidify at room temperature, and it isn't recommended to store it in the refrigerator. It should have a light creamy texture without separating the oil throughout its shelf life of 6-12 months. Due to differences in culture and laws, the composition of chocolate is different from country to country [21]. The chocolate spread usually contains cocoa powder, vegetable or palm oil, sugar, and additional flavoring [31]. For chocolate production, all components must be well mixed, which allows them to be divided into homogeneous particles of suitable dimensions, and then followed by hardening and ripening processes [34]. The chocolate consumed today is usually a mixture of cocoa powder, cocoa butter, or vegetable oils, and sugar, and chocolate is rich in caffeine, contrary to popular belief [32].

The food industry produces huge amounts of by-products rich in antioxidants, phenols and flavonoids, that can be used as functional ingredients in many foods (meat, bakery, and dairy products), which have a significant environmental and economic impact, and provide consumers with healthy options [26]. Date seeds are a by-product of the manufacture of seedless dates, date paste, date molasses, and many sweets. Recently, it was possible to benefit from the by-products of the various food industries in the manufacture of many products with high nutritional value [14, 27, 26]. A study conducted by Mrabet et al. [25] showed that date seeds contained protein, carbohydrates, fibers, high concentrations of minerals, including (Ca, Mg, K, Na, Fe, and P), and oil (5 -13%), which is rich in tocopherols, phytosterols, phenols, vitamins, and fatty acids (oleic, linoleic, palmitic, myristic, and lauric).

Based on what has been shown of the importance of date seed and the high nutritional value of their various varieties, and given their richness in minerals, fiber, antioxidants, and phenols, and the recent trend to benefit from them by adding them to some products to enhance their nutritional value, in addition to the lack of local studies on the possibility of making chocolate from date seed powder and the scarcity of Foreign studies, so this research aimed to study some chemical indicators, color indicators, total phenols content, antioxidant activity, and organoleptic properties of cocoa samples and date seed powder, and studying the effect of total and partial replacement of cocoa with date seed powder on the quality characteristics of processed chocolate samples.

2-Materials and Methods:

- Materials:

Raw materials required for the manufacture of chocolate were purchased, which are: date (Ajwa date variety), cocoa, sunflower oil, milk powder, sugar powder, vanilla, salt, and lecithin, from the local market of Damascus city.

This research was conducted at the laboratories of (The Food Sciences Department, Faculty of Agriculture, Damascus University, and the General Authority for Biotechnology at the Faculty of Agricultural Engineering, Damascus University), during 2020-2021AD.

- Methods:

1- **Date Seed Powder Preparation:** Date seed powder was prepared according to the method described by [11, 20] with some modifications, as the date seed was separated from the fleshy part of the date fruit, after that seeds were soaked in hot water (100 °C) for a one hour, then washed well with water to get rid of the outer covers and any sticky fleshy part, to be placed in trays, then dried in the sun for two

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days, then dried using hot air at 60˚C for 6 hours, then roasted at a temperature of 125°C for 30 minutes until it became breakable by hand and to obtain a brown color similar to the flavor and aroma of cocoa, then they were left to cool, and then seeds were ground well using a commercial electric mill (Syria), and sifted using a sieve (60 mesh) until a fine brown powder (date seed powder) was obtained, then it was placed in dark glass containers and sealed tightly.

2- Chocolate Spread Preparation: Chocolate spread was manufactured using different proportions of cocoa and date seed powder according to the proportions given in Table (1), according to the method described by [12, 22], with some modifications, as the dry ingredients (cocoa, milk powder, sugar powder, salt, and vanilla) were mixed well until the mixture was completely homogeneous, and then placed in an electric mixer, then vegetable oil and lecithin were gradually added to it until the desired consistency of liquid chocolate was obtained.

Table (1): Cocoa Powder and Date Seed Powder Percentages Used in Chocolate Samples Processing

Chocolate samples	Cocoa powder (%)	Date seed powder (%)
10% Cocoa powder (control)	10	0
8% Cocoa powder+2%date seed powder	8	2
6% Cocoa powder+4%date seed powder	6	4
10% date seed powder	0	10

In this research, chocolate (control sample) was made using the following ingredients: white sugar powder 47%, milk powder (3.5% fat) 15%, cocoa 10%, sun flower oil 27%, lecithin 0.7%, vanilla 0.015%, sodium chloride salt 0.018%, while other chocolate samples were manufactured in the same way as the control chocolate, but with the replacement of cocoa powder with different proportions of date seed powder (2, 4, 10%).

Chemical Tests:

- **Moisture:** Moisture was estimated by drying at a temperature of 105°C until constant weight according to the method provided in [6], using a drying oven (Kottermann, model 2701), and the dry matter was calculated from the equation:

Dry matter % = 100-% moisture

- **Ash:** Ash was estimated by burning the sample at a temperature of 550°C until all the organic matter was burned using a Wise-Therm incinerator [6].

- **Total sugars:** Total sugars were estimated in the samples using Lane and Eynon test according to the method presented in [6].

- **Crude Fibers:** Crude Fibers were estimated according to [5], by taking 1 g of the fat-free sample, extracted by petroleum ether, and put in a flask, then adding 200 ml of dilute sulfuric acid 1.25% to it, and boiling it for 30 minutes, then the contents were transferred to another flask, 200 ml of sodium hydroxide 1.25% was added to it, and it was boiled for 30 minutes again in the presence of a condenser, then the contents of the sample were filtered, and washed with boiling water, and dilute sulfuric acid 1.25%, then with ethanol, then the remaining materials were dried at 130°C for at least 2 hours and cooled, then the sample in the

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crucible was burned at 550°C until any organic matter (black colour) has disappeared and the weight was constant, then the crucible cooled down in a desiccator and weighed, and the percentage of crude fibers was calculated according to the following:

Crude fiber%=100*(weight after drying - weight after incineration)/(sample weight)

- **pH:** pH number was measured using a laboratory electrical pH meter model 5310, manufactured by the British company (JENWAY), according to AOAC [6].
- **Total Phenols:** They were quantitatively determined using the (Folin-Ciocalteu) method mentioned by Asami et al. [9], and the absorbance was measured by spectrophotometer at a wavelength of 750 nm. Gallic acid was used as a reference standard solution to prepare the standard curve with a concentration ranging from (0-375 PPM) and the results were expressed as (mg equivalent Gallic acid / 100g sample).
- **Antioxidant Activity According to The Free Radical Method, Diphenyl Picryl-Hydrazyl (DPPH):** The free radical inhibiting activity of the sample extract was measured according to the method used by Abohadra & Tlay [1], and the absorbance was measured at a wavelength of 517 nm after 30 min, and the antioxidant activity was expressed by calculating the inhibition percentage of free radicals.
- **Color Indices (L*, a*, b*):** Color indices (L*, a*, b*) were assigned using the Hunter Lab instrument according to Tlay et al. [33]. L* (Lightness) indicates the lightness, a* (Redness/Greenness) indicates the redness, a positive value indicates red, a negative value indicates green, b* (Yellowness/Blueness) indicates the yellowness, a positive value indicates the color is yellow and a negative value indicates blue.
- **Sensory Properties:** Sensory properties were conducted by a group of 15 persons using the Hedonic Scale, according to the method described by Ruicong et al [29]. Samples were provided to 15 persons, and the committee members evaluated chocolate samples, using the pleasure scale of 5 points for (taste, color, smell, texture, and bitterness), and the number (5) was given to represent the phrase I like very much, and the number (1) to represent the phrase I do not like very much.

Statistical Analysis: The General Linear Model was used to calculate means and standard deviation, and the Minitab statistical program was used at a significant level of 5% to find significant differences between means by three replicates.

3- Results and Discussion:

1- Studying Some Chemical Indicators of Cocoa and Date Seed Powder Samples:

Results in Table (2) show that the percentage of moisture in the cocoa powder sample amounted to 3.50%, and decreased to 2.33% in the date seed powder sample. Also, it was noted that the percentage of ash in the cocoa sample increased compared with the date seed powder sample, as the percentage of ash in cocoa powder was 4.50% and increased to 7.51% in the date seed powder sample. The date seed powder sample was distinguished by its high fiber content (79.31% dry weight basis) compared with cocoa powder (37.06% dry weight basis).

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Table (2): Chemical Indicators Of Cocoa Powder and Date Seed Powder Samples

Sample	Moisture (%)	Total solid (%)	*Total sugar (g/100 g)	Ash (%)	pH	**Crud Fiber (%)
Cocoa Powder	3.50±0.55	96.50±0.55	2.50±0.82	4.50±0.08	7.45±0.05	37.06±0.47
Date Seed Powder	2.33±0.32	97.67±0.32	5.28±0.64	7.51±0.04	4.91±0.06	79.31±0.29

Mean ± SD values in each column, * Total sugar (g/100 g dry weight), **Crud Fiber (% dry weight)

In addition, the pH number in the cocoa powder sample increased to (7.45) compared with (4.91) in the date seed powder sample. Ha et al. [12] indicated that the moisture content of cocoa beans ranged between (5.64-6.99%) and ash (2.47-3.67%) on a wet weight basis. Joel et al. [18] indicated that the percentage of moisture in cocoa powder ranged between (5.12-7.10%), pH number (3.91-5.92), fat (10.05-12.65%), crude fiber (1.06-2.64%), ash (5.32-6.41%), and carbohydrates (61-62.47%), and this difference is due to the different duration of cocoa fermentation, roasting temperatures and drying temperature used, and Joel et al. [18] indicated that the moisture content of cocoa powder was (6.20%), fat (11.28%), protein (8.14%), fiber (1.80%), ash (5.81%), and carbohydrates (61.74%). Darwish et al. [10] indicated that roasted date seed powder contains dry matter, fat, protein, ash, fiber, total phenols, and antioxidant activity amounted to (98.1%, 8%, 5.2%, 1.2%, 76.6%, 38.3%, 83.9%), respectively. Based on what was presented by Algarni [3], date seed powder contains a high percentage of carbohydrates and fibers reached to (52.87% and 67.56%), respectively, and contains protein, fat, and ash amounted to (7.73%, 7.90%, 4.35%), respectively. Afoakwa et al. [2] indicated that the percentage of moisture in cocoa powder ranged between (3.8-4.9%), fat (50.4-55.2%), protein (17.6-21.6%), ash (2.3-3.5%), and carbohydrates (15.5-24.7%). This difference is due to the different duration of cocoa fermentation and whether these beans are fermented or not.

2- Some Chemical Indicators Of Processed Chocolate Samples:

Table (3) shows the results of the effect of replacing cocoa with different proportions of date seed powder on some chemical indicators of studied chocolate samples.

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Table (3): Chemical Indicators Of The Studied Chocolate Samples

Samples	Moisture (%)	Total solid (%)	Ash (%)	*Total sugar	**Crud Fiber (%)	pH
CC	12.14± 0.27^{d}	87.86± 0.27^{a}	0.46± 0.001^{a}	44.35± 0.66^{d}	2.85± 0.52^{a}	7.77± 0.01^{d}
CCDSP1	9.80±0.69^{bc}	90.20±0.69^{b}	0.52±0.06^{b}	34.15±0.32^{c}	3.68±0.21^{b}	7.62±0.02^{c}
CCDSP2	9.60±0.39^{b}	90.40±0.24^{bc}	0.60±0.12^{c}	26.55±0.22^{b}	4.61±0.61^{c}	7.39±0.01^{b}
CDSP3	9.20±0.14^{a}	90.80±0.19^{d}	0.77±0.016^{d}	20.33±0.24^{d}	5.97±0.38^{d}	7.06±0.03^{a}

Mean ± SD values in each column with different superscript letters (a, b, c, d) are significant at (p≤ 0.05).
*** Total sugar (g/100 g dry weight), **Crud Fiber (% dry weight)**
CC: control chocolate processing from (10% cocoa powder), CDSP1: chocolate processing from (8% cocoa powder + 2% date seed powder), CDSP2: chocolate processing from (6% cocoa powder + 4% date seed powder), CDSP3: chocolate processing from (10% date seed powder).

Results in table (3) show that there is a moral decrease in the percentage of moisture with an increase in the percentage of replacing cocoa with date stone powder, as the moisture percentage decreased in the sample of chocolate manufactured using 10% of powdered date seed to (9.20%) compared with the control sample (12.14%).

Chocolate samples showed a moral increase in their ash content with an increase in the percentage of cocoa powder replacement with date seed powder, compared with the control sample, as the percentage of ash in the control sample was 0.46%, reaching its highest value (0.77%) in a manufactured sample using Date seed powder by 100%, and this can be attributed to the high mineral content of date seed powder, as Habib & Ibrahim [16] indicated, when studying date seed belonging to 18 varieties grown in the United Arab Emirates, that they were rich in minerals, as their iron content ranged between (1.32-3.44 mg/100g), and phosphorous ranged between (110.09-173.07 mg/100g), while its potassium content ranged between (110.09-146.77 mg/100g).

Mistrello et al. [24] indicated that date seeds were one of the sources rich in mineral content when studying three different cultivars, as they were characterized by their high content of potassium (280.55-293.13 mg/100g), iron (0.51-2.49 mg/100g), and magnesium (44.52-47.60 mg/100g). Joel et al. [18] also indicated that the moisture content of chocolate samples made from cocoa powder ranged between (5.15-6.23%), pH (5.65-6.51), fat (31.25-35.10%), crude fiber (3.16-2.24%), and ash (1.88-2.23%), due to the difference in the fermentation time of cocoa beans used in the manufacture of cocoa powder which used in the processing of chocolate.

Results in the table referred to a significant decrease in the total sugars content of studied chocolate samples with an increase in the percentage of Date seed powder compared with the control sample, as the percentage of total sugars in the control sample was (44.35 g/100 g

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dry weight) (10% Cocoa powder), and decreased by 23% in the chocolate sample (8% cocoa powder and 2% date seed powder), and by 40.14% in the chocolate sample (6% cocoa powder and 4% Date seed powder), and by 54.16% in the sample manufactured using Date seed powder 100%.

Also, results show in Table (3) an increase in the percentage of crude fibers in the studied chocolate samples, with an increase in the percentage of date seed powder compared with the control sample, as the percentage of crude fibers reached (2.85% dry weight) in the control sample (10% cocoa powder), and it increased by 29.12% in the chocolate sample (8% cocoa powder and 2% date seed powder), and by 61.75% in the chocolate sample (6% cocoa powder and 4% date seed powder), and by 109.47% in the sample manufactured using date seed powder with a percentage of 10%. Katz et al. [19] indicated that although cocoa bean shells are rich in fiber, and consumption of cocoa beans has been shown to improve the LDL: HDL ratio, much of it is lost during manufacturing processes and thus a small percentage of fiber remains in various commercial cocoa products including cocoa powder. Joel et al. [18] indicated that the percentage of fiber in cocoa powders prepared from cocoa beans, whose fermentation time varied from one to seven days, ranged between (1.06-2.64%), while date seeds are characterized by their high content of fibers, the percentage of crude fibers in seven different varieties of seeds ranged between (17.07-23.46%), according to [4]. Algarni [3] indicated that the content of sugary variety date seed from crude fiber amounted to 27.15%, which explains the high fiber content of studied chocolate samples with the increase in the percentage of date seed powder added.

As for the pH number, we note from the table that the pH number value in the control sample increased significantly compared with the other three studied samples, as the pH number was (7.77), while in the sample (8% cocoa + 2% date seed powder) its value was (7.62). The chocolate sample (10% date seed powder) had the lowest pH (7.06). The gradual decrease in the pH number as the percentage of date seed powder increases in the samples can be explained by the fact that cocoa powder and other by-products generated during the manufacturing process of cocoa beans are usually treated with alkaline solutions under the influence of pressure and heat, which increases their solubility, and improves some of their organoleptic properties such as color and flavor. Accordingly, it is classified according to its degree of acidity into Normally alkaline pH (5-6), slightly alkaline pH (6-7.2), moderately alkaline pH (7.2-7.6), and strongly alkaline pH (>7.6), which often impart darker color-added products with a less astringent flavor and better solubility [28, 23]. Joel et al. [18] indicated that the percentage of moisture in chocolate ranged between (5.15-6.23%), pH (5.65-6.51), fat (31.25-35.10%), crude fiber (2.24-3.16%), ash (1.88-2.46%), carbohydrates (40.32-46.54%), and this difference is due to the type of cocoa used in the manufacturing of chocolate. Darwish et al. [10] indicated in their study the effect of adding roasted date seed powder in different proportions (0, 1, 5, 10%) on the texture and sensory properties of cheese spread, the results showed that roasted date seed powder contained a higher percentage of total phenols (38.3 mg Gallic acid/g) and flavonoids (33.4 mg quercetin /g), and antioxidant activity (83.9%), the addition of roasted date seed powder led to significant differences in total solids and fiber content, and slight differences in the fat and protein content, the lowest ash content was recorded at 3.20% and the lowest soluble nitrogen was 1.68% in the 10% treatment. The pH values increased significantly by adding the powder, with a relative increase in phenols, flavonoids, and antioxidant activity with the increase in the proportion of the added powder, all samples were sensory acceptable, and 5% and 1% obtained the highest general acceptance scores.

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3- Total Phenols Content and Antioxidant Activity of Processed Chocolate Samples:

Table (4): Total Phenols Content and Antioxidant Activity of The Studied Chocolate Samples

Sample	Total phenols* (mg equivalent Gallic acid / 100g sample)	Antioxidant activity (%)
CC	968.64± 0.67[a]	80.23± 0.47[a]
CCDSP1	1138.59±0.39[b]	81.66±0.10 [b]
CCDSP2	1374.59±0.48 [c]	82.44±0.28 [c]
CDSP3	1382.18±0.19 [d]	83.36±0.55 [d]

Mean ± SD values in each column with different superscript letters (a, b, c, d) are significant at (p≤ 0.05), *Total phenols (mg equivalent Gallic acid / 100g sample, dry weight)
CC: control chocolate processing from (10% cocoa powder), CDSP1: chocolate processing from (8% cocoa powder + 2% date seed powder), CDSP2: chocolate processing from (6% cocoa powder + 4% date seed powder), CDSP3: chocolate processing from (10% date seed powder).

Table (4) shows the total phenols content and the antioxidant activity of chocolate samples manufactured using date seed powder as a substitute for cocoa at different proportions compared with the control sample (10% cocoa).

When compared to the control sample, the chocolate samples' total phenol content increased as the percentage of date seed powder replacing cocoa powder increased, reaching 1138.59 mg equivalent Gallic acid per 100 g dry weight in the sample with (8% cocoa and 2% date seed powder) and reaching its highest value of (1382.18 mg equivalent Gallic acid per 100 g dry weight) in the sample with 10% date seed powder. These findings are presented in Table 4. The sample's total phenol content was found to have increased by 17 percent with the addition of date seed powder (8% cocoa and 2% date seed powder), and by 41.91% in the sample (6% cocoa and 4% date seed powder), and with a rate of 42.69% in the sample (10% date seed powder). This can be attributed to the high total phenols content of date seed powder. Mistrello et al. [24] indicated the richness of date seeds (Deglet Nour, Khawat Aleik, Al-Zahidi) with total phenols, and ranged between (2058-2984 mg equivalent Gallic acid / 100g). Ardekani et al. [7] when studying date seeds belonging to 18 varieties in Iran concluded that date seeds are a source of phenols and natural antioxidants, which can be exploited in many fields, including pharmacological ones, as its content of total phenols ranged between (459-3284 mg equivalent Gallic acid / 100g).

Table 4 shows that the chocolate sample prepared from date seed powder was significantly superior to (10%) in its antioxidant activity, reaching (83.36%), while the antioxidant activity in the control sample made from cocoa 10% reached (80.23%), as the percentage of date seed powder decreased, and the percentage of cocoa powder used in chocolate production increased. This can be explained by the fact that by-products of date industries, including seeds, have high levels of antioxidants, inhibition of lipid oxidation, and

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the ability to chelate minerals. Algarni [3] indicated that date seed powder is a rich source of various polyphenol compounds with antioxidant properties, as the antioxidant activity of the sugary date seed powder reached 57.25%. Darwish et al. [10] indicated a relative increase in phenols, flavonoids, and antioxidant activity with an increase in the proportion of roasted date seed powder added to the spread cheese, due to the fact that date seed powder contains total phenols and antioxidant activity (38.3, 83.9%), respectively.

4- Color Indicators Of Processed Chocolate Samples:

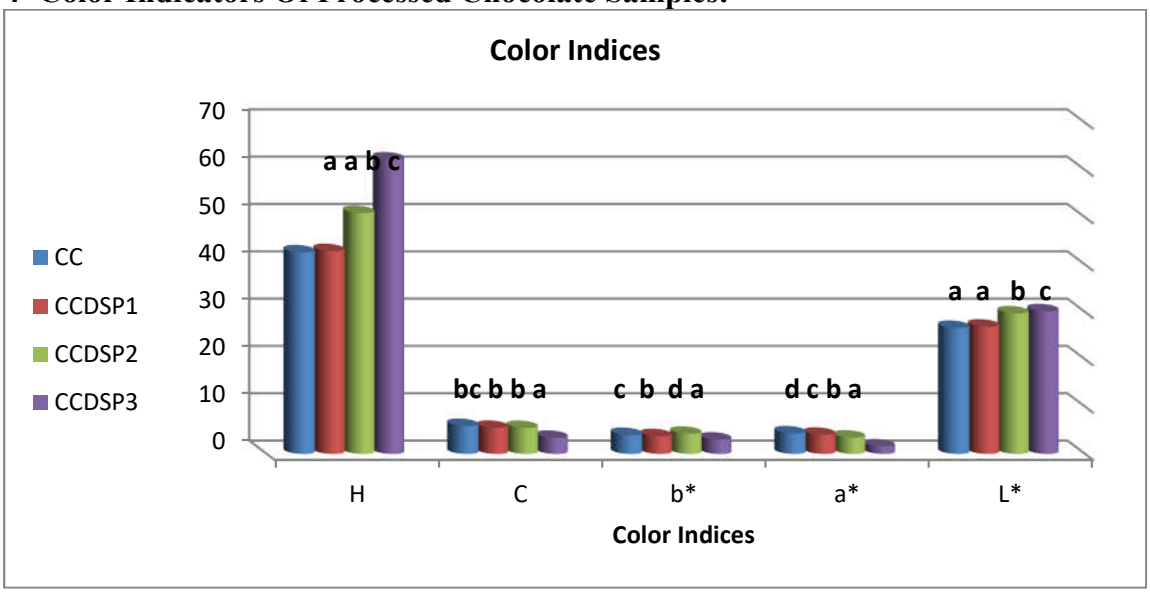

Figure 1: Color Indices Of The Studied Chocolate Samples

a, b, c, d,.. :Different superscripts within the same column represent significant differences between the results (p≤ 0.05), L* (lightness), a* (redness: green to red), b* (yellowness: blue to yellow), h (hue value, color angle), C (chroma value, color saturation). CC: Control chocolate processing from (10% cocoa powder), CDSP1: Chocolate processing from (8% cocoa powder + 2% date seed powder), CDSP2: Chocolate processing from (6% cocoa powder + 4% date seed powder), CDSP3: Chocolate processing from (10% date seed powder).

Results referred in a figure (1) to a significant increase in the value of the two color indicators (L* and H) for chocolate samples made from date seed powder by 10% and a moral decrease in the (a*, b*, and C) values indicators compared to the other studied samples, as a result of the high percentage of addition of date seed powder. According to Lab, the L value of samples varies according to the degree of roasting used, and according to the results of this study, it is clear to us that the chocolate samples that we obtained are classified as medium-dark samples.

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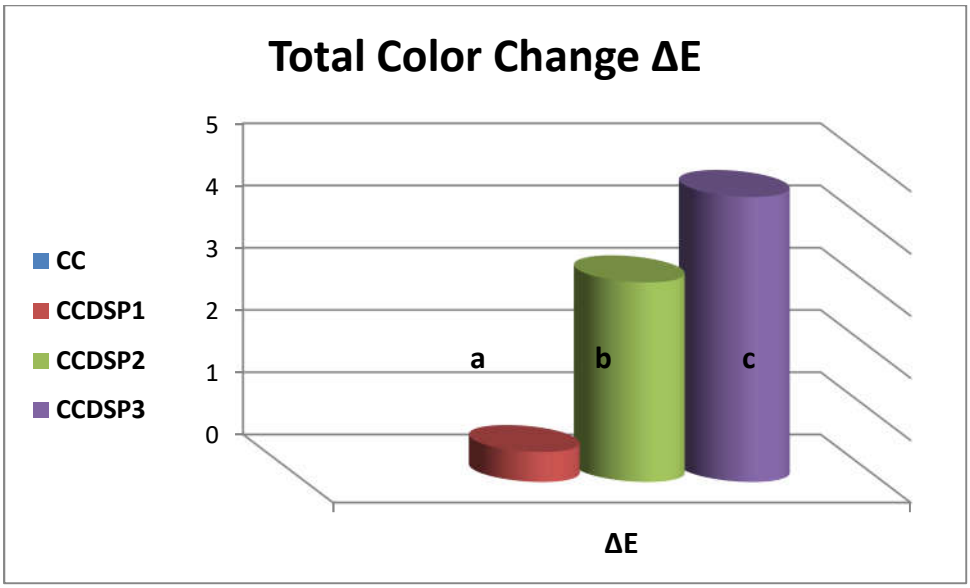

Figure 2: Total Color Change Of The Studied Chocolate Samples
a, b, c, d: Different superscripts within columns represent significant differences between the results (p≤ 0.05), ΔE: Total Color Change, CC: Control chocolate processing from (10% cocoa powder), CDSP1: Chocolate processing from (8% cocoa powder + 2% date seed powder), CDSP2: Chocolate processing from (6% cocoa powder + 4% date seed powder), CDSP3: Chocolate processing from (10% date seed powder).

The results in Figure 2 indicate the total color change in chocolate samples manufactured by replacing cocoa powder with different proportions of date seed powder, compared to the control chocolate sample (cocoa powder), where the addition of date seed powder in different proportions led to a total change in color with proportions of (6%, 39%, 55%) when replacing with ratios (2, 4, 10%), respectively.

5- Sensory Characteristics Of Processed Chocolate Samples:

Figure (2) shows the sensory characteristics of chocolate samples manufactured using date seed powder and cocoa.

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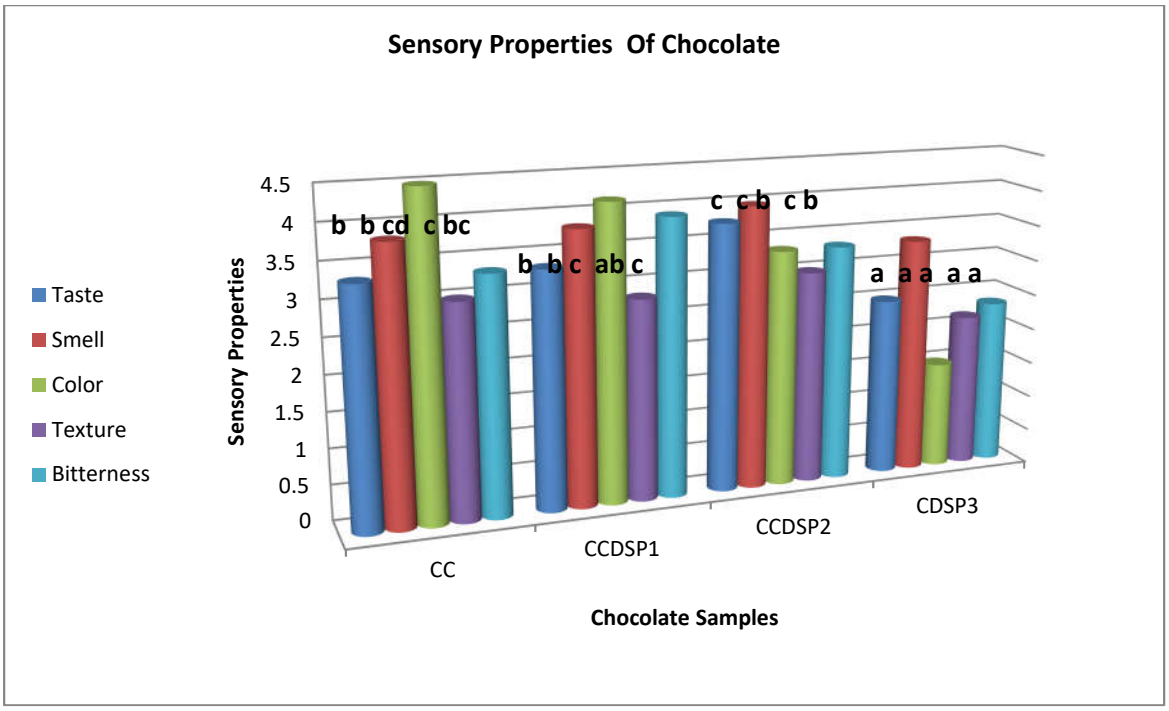

Figure 3: Sensory Properties Of The Studied Chocolate Samples
a, b, c, d,..: Different superscripts within the same column represent significant differences between the results (p≤ 0.05), CC: control chocolate processing from (10% cocoa powder), CDSP1: chocolate processing from (8% cocoa powder + 2% date seed powder), CDSP2: chocolate processing from (6% cocoa powder + 4% date seed powder), CDSP3: chocolate processing from (10% date seed powder).

Results shown in Figure (3) that the sample manufactured using 4% of date seed powder was significantly superior in taste (3.77), smell (3.98), and texture (3.10) compared to other studied samples. In contrast, the addition of date seed powder at a rate of 2% had the greatest effect on the degree of bitterness (3.91), as the control sample was significantly superior to most of the studied samples in color (4.50), and studied sensory characteristics (taste, smell, color, texture, bitterness) of a sample prepared from date seed powder (10%) were low compared to other studied samples. It should be noted that there were no significant differences in most of the studied sensory characteristics (taste, smell, color, bitterness) between the control sample and the chocolate sample manufactured using 2% of date seed powder .

These results contradicted what was indicated by Erukainure et al. [3] in studying the sensory properties of chocolate samples fortified with different percentages of date seed (17.94, 19.86, 25.16%), as it was noted that the sample fortified with the lowest percentage of date seed powder was superior in taste and texture compared with other studied samples and control. These results agreed with what was indicated by Khalil & Blassey [20] were evaluated the sensory properties of low-fat ice cream samples, in which date seed powder was used as an alternative to cocoa with percentages of (3.5, 2.5%), as it was observed that the sample manufactured by adding 3.5% of date seed powder was superior in taste, texture, and general acceptance compared to other studied samples. Darwish et al. [10] indicated in their study that all samples of cheese spread fortified

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with date seed powder were sensory acceptable, with 5% and 1% obtaining the highest levels of general acceptance.

Conclusions:

Compared to the date seed powder sample, the results revealed a higher percentage of moisture, and pH in the cocoa powder sample. In contrast, the date seed powder sample had the highest ash and fiber content compared to cocoa powder.

The processed chocolate samples showed a significant increase in the content of ash and raw fibers, and a moral decrease in the rate of moisture, total sugars, pH, the content of total phenol, and antioxidant activity, with an increase in the proportion of replacing cocoa powder with date seed powder, compared with the control sample.

There was a significant increase in the color indicators values (L and H) for chocolate samples made from date seed powder by 10% and a significant decrease in the (a, b, and C) values compared to the other studied samples, with an increase in the percentage of date seed powder.

The sample manufactured using 4% of date seed powder was significantly superior in taste, smell, and texture compared to other studied samples. In contrast, date seed powder added by 100% had the highest significant effect on the degree of bitterness, as the control sample was significantly superior in color compared to the studied samples.

References

Abohadra, A. A. & Tlay, R. H. (2021). The effect of tomato pomace powder addition on the biscuit content of bioactive compounds and antioxidant activity during storage. Journal of Agricultural, Environmental and Veterinary Sciences, 5(4), 9-21. https://doi.org/10.26389/AJSRP.D120621 (In Arabic)

1. Afoakwa, E.O., Quao, J., Takrama, J., Budu, A.S. & Saalia, F.K. (2013). Chemical Composition And Physical Quality Characteristics Of Ghanaian Cocoa Beans As Affected By Pulp Pre-Conditioning And Fermentation. *Journal of Food Science and Technology*, 50(6), 1097–1105. DOI: 10.1007/s13197-011-0446-5.
2. Algarni, E. H. A. (2020). Utilization from date seeds as a by-product low-cost to prepare beverage cappuccino and the latte less caffeine. World Journal of Environmental Biosciences, 9(2), 14-20.
3. AL-Juhaimi, F. Ghafoor, and K. Özcan, M. (2012). Physical And Chemical Properties, Antioxidant Activity, Total Phenol And Mineral Profile Of Seeds Of Seven Different Date Fruit (Phoenix Dactylifera L.) Varieties. International *Journal of Food Sciences and Nutrition*, 63(1), 84–89. DOI: 10.3109/09637486.2011.598851.
4. AOAC, (2005). Association of Official Agricultural Chemists. Approved methods of the AOAC (18th ed.)
5. AOAC. (2008). Official Methods Of Analysis 16th Ed. Association Of Official Analytical Chemists International Arligton, Virginia, USA.
6. Ardekani, M. R. S., Khanavi, M., Hajimahmoodi, M., Jahangiri, M., & Hadjiakhoondi, A. (2010). Comparison of antioxidant activity and total phenol contents of some date seed varieties from Iran. Iranian journal of pharmaceutical research: Iranian Journal of Pharmaceutical Research, 9(2), 141-6.
7. Arunkumar, K, & Jegadeeswari V. (2019). Evaluating The Processed Beans Of Different Cocoa (*Theobroma Cacao* L.) Accessions For Quality Parameters. *Journal of Phytology*, 11, 01-04. DOI:10.25081/jp.2019.v11.20190115.
8. Asami, D. K., Hong, Y. J., Barrett, D., M. & Mitchell, A. E. (2003). Comparison Of The Total Phenolic And Ascorbic Acid Content Of Freeze-Dried And Air-Dried Marionberry, Strawberry, And Corn Grown Using Conventional, Organic, And Sustainable Agricultural Practices. *J. Agric. Food*

ISSN 2072-3857

Chemistry, 51(5),1237-124. DOI: 10.1021/jf020635c.

9. Darwish, A. A.; Tawfek, M. A. and Baker, E. A. (2020). Texture, Sensory Attributes and Antioxidant Activity of Spreadable Processed Cheese with Adding Date Seed Powder. *Journal of Food and Dairy Sciences*, 11 (12), 377 – 383. DOI: 10.21608/jfds.2021.60281.1014.
10. El Sheikh, M., El-Kholany, A. E. & Kamel, S. M. (2014). Nutritional Value, Cytotoxicity, Anti-Carcinogenic And Beverage Evaluation Of Roasted Date Pits Dalia. *World Journal of Dairy and Food Sciences*, 9 (2), 308-316. DOI: 10.5829/idosi.wjdfs.2014.9.2.91144.
11. El-kalyoubi, M., Khallaf, M. F., Abdelrashid, A. & Mostafa, E. M. (2011). Quality Characteristics Of Chocolate – Containing Some Fat Replacer. *Annals of Agricultural Sciences*, 56(2), 89–96. DOI:10.1016/j.aoas.2011.05.009.
12. Erukainure, O. L., Egagah, T. I., Bolaji, P. T., & Ajiboye, A. J. (2010). Development and quality assessment of date chocolate products. American Journal of Food Technology, 5(5), 324-330. DOI : 10.3923/ajft.2010.324.330
13. Ghnimi S., Almansoori, R. Jobe, B. Hassan, M.H. & Afaf, K.E. (2015). Quality Evaluation Of Coffeelike Beverage From Date Seeds (Phoenix Dactylifera, L.). *Journal of Food J Processing & Technology*, 6(12), 1–6. DOI: 10.4172/2157-7110.1000525.
14. Ha, L.T.V, Nusantoro, B., Phillip, R.A., Anh, P.H., Toan, H.T., Messens, K. and Dewettinck, K. (2016). Physico-Chemical Properties Of Fourteen Popular Cocoa Bean Varieties In Dongnai – Highland Vietnam. Can Tho University Journal of Science, 4, 81-86. DOI: 10.22144/ctu.jen.2016.046.
15. Habib, H. M., & Ibrahim, W. H. (2008). Nutritional Quality Evaluation Of Eighteen Date Pit Varieties. *International Journal of Food Sciences & Nutrition*, 60, 99-111. DOI: 10.1080/09637480802314639
16. ICCO. (2020). ICCO document: Annual report 2019/2020. International Cocoa Organization.
17. Joel, N., Pius, B., Deborah, A. & Chris, U. (2013). Production And Quality Evaluation Of Cocoa Products (Plain Cocoa Powder And Chocolate). *American Journal Of Food And Nutrition*, 3(1), 31-38. DOI:10.5251/ajfn.2013.3.1.31.38.
18. Katz, D. L., Doughty, K., & Ali, A. (2011). Cocoa and chocolate in human health and disease. Antioxidants & redox signaling, 15(10), 2779-2811.
19. Khalil, R. A. M. & Blassey, K. I. (2016). Novel Functional Low Fat Ice Cream Flavored With Roasted Date Seed. *Egyptian Journal of Dairy Science*, 44, 137-149.
20. Melo C. W. B. D., Bandeira, M. D. J., Maciel, L. F., Bispo, E. D. S., Souza, C. O. D. & Soares, S. E. (2020). Chemical Composition And Fatty Acids Profile Of Chocolates Produced With Different Cocoa (*Theobroma Cacao* L.) Cultivars. *Food Science and Technology*, 40(2), 326-333. DOI: org/10.1590/fst.43018.
21. Melo, L. L. M. M. D., Bolini, H. M. A. & Efraim, P. (2009). Sensory Profile, Acceptability, And Their Relationship For Diabetic/Reduced Calorie Chocolates. *Food Quality and Preference*, 20(2), 138-143.
22. Miller, K. B., Hurst, W. J., Payne, M. J., Stuart, D. A., Apgar, J., Sweigart, D. S., & Ou, B. (2008). Impact of alkalization on the antioxidant and flavanol content of commercial cocoa powders. Journal of agricultural and food chemistry, 56(18), 8527-8533. DOI:10.1021/jf801670p
23. Mistrello, J., Sirisena, S. D., Ghavami, A., Marshall, R. J., & Krishnamoorthy, S. (2014). Determination of the antioxidant capacity, total phenolic and flavonoid contents of seeds from three commercial varieties of culinary dates. International Journal of Food Studies, 3(1), 34-44.

ISSN 2072-3857

24. Mrabet, A., Jiménez-Araujo, A., Guillén-Bejarano, R., Rodríguez-Arcos, R., & Sindic, M. (2020). Date seeds: A promising source of oil with functional properties. Foods, 9(6), 787. doi: 10.3390/foods9060787
25. Najjar, Z., Kizhakkayil, J., Shakoor, H., Platat, C., Stathopoulos, C., & Ranasinghe, M. (2022). Antioxidant potential of cookies formulated with date seed powder. Foods, 11(3), 448. DOI: 10.3390/foods11030448
26. Platat, C., Habib, H. M., Hashim, I. B., Kamal, H., AlMaqbali, F., Souka, U., & Ibrahim, W. H. (2015). Production of functional pita bread using date seed powder. Journal of food science and technology, 52, 6375-6384. doi.org/10.1007/s13197-015-1728-0
27. Quelal-V´ asconez, M. A., Lerma-García, M. J., P´erez-Esteve, E., ´ Talens, P., & Barat, J. M. (2020). Roadmap of cocoa quality and authenticity control in the industry: A review of conventional and alternative methods. Comprehensive Reviews in Food Science and Food Safety, 19(2), 448–478. https://doi.org/10.1111/1541-4337.12522
28. Ruicong, Z., Lei, Z. & Jingye, S. (2016). Improving The Sensory Quality Of Flavored Liquid Milk By Engaging Sensory Analysis And Consumer Preference. *Journal of Dairy Science*, 99(7), 5305–5317. DOI: org/10.3168/jds.2015-10612
29. Rusconi, M. & Conti, A. (2010). *Theobroma Cacao* L., The Food Of The Gods: A Scientific Approach Beyond Myths And Claims. *Pharmacological Research*, 61(1), 5-13. DOI: 10.1016/j.phrs.2009.08.008.
30. Said, A., Nasir, N. A. M., Abu Bakar, C. A. & Mohamad, W. A. F. W. (2019). Chocolate Spread Emulsion: Effects Of Varying Oil Types On Physico-Chemical Properties, Sensory Qualities And Storage Stability. *Journal Of Agrobiotechnology*, 10(2), 32-42. E-ISSN:2180-1983.
31. Shafi, F., Reshi, M., Bashir, A. and Iqra. (2018). Chocolate Processing. *International Journal of Applied Business Research*, 8 (3), 408-419. ISSN 2250 – 3579.
32. Tlay, R.H.; Abdul-Abbas, S.J.; El-Maksoud, A.A.A.; Altemimi, A.B. and Abedelmaksoud, T.G. (2023). Functional biscuits enriched with potato peel powder: Physical, chemical, rheological, and antioxidants properties. Food Systems, 6(1): 53-63. https:// doi.org/10.21323/2618-9771-2023-6-1-53-63
33. Veronika, B., Mirela, K., Antun J., Ivana F., Duridca Aˇ., Borislav M., Drago Š., Stela J. & Jurislav B. (2019). The Chemistry Behind Chocolate Production. *Molecules*, 24(17), 1-13. DOI:10.3390/molecules24173163

ISSN 2072-3857

ISSN 2072-3857