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# QUALITY OF CHOCOLATE ICE MILK SUPPLEMENTED WITH DRIED BLACK GRAPE POMACE

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**ABSTRACT:** Supplementation ice milk treatments with dried black grape pomace powder (DBGP) were at the rate of 0.0, 1.0, 2.0, 3.0, and 4.0 %. Specific gravity and weight per gallon of ice milk mixture increased by increasing the rate of supplementation with BGPP. Supplementation of chocolate ice milk with DBGP caused a significant increase in specific gravity, weight per gallon, melting resistance, total solids, protein, ash, dietary fiber, total phenolic compounds contents, and antioxidant activity. Adding DBGP up to 2.0% didn't affect the overrun of chocolate ice milk, while the rate of supplementation decreased the chocolate ice milk overrun treatments. Chocolate ice milk treatment additions of 2.0% and 3.0% DBGP gained the highest values of organoleptic properties. The total phenolic compounds content and antioxidant activity of chocolate ice milk decreased as the storage period proceeded, while acidity, pH values, total solids, fat, protein, and dietary fiber contents didn't change throughout the storage period of chocolate ice milk.

**Keywords:** Chocolate ice milk, black grape pomace powder, dietary fiber, total phenolic compounds, antioxidant activity.

## INTRODUCTION

Using the new technology, different flavours, colors, functional ingredients, and probiotic bacteria enables the manufacturers of ice cream to produce different forms and types of ice cream, therefore their consumption in Egypt and the world recently has increased markedly (Hamed *et al.*, 2014; Akbari *et al*., 2016; Ayar *et al*., 2018 and Kebary *et al.*, 2018).

Cultivated grapes (*Vitis vinifera* L. *Vitaceae*) all over the world with a total area under vines was reaching in 2019, of 7.4 million hectares with Spain (13.1%), China (11.5%), France (10.7%), and Italy (9.6%) representing, almost, 45% of the world's vineyard (OIV, 2020). In Egypt, grapes are considered the second main crop production after citrus, with almost 200,000 Tons/year fruits, in which the by-product pomace represents about 10 to 20 thousand Tons/year (Ministry of Agriculture Egypt, Agricultural Development System Project, ADS, 2006). There are three main categories of grapes, namely wine grapes, table grapes, and dried grapes.

Grape pomace (GP) is the main residue of grape processing, composed of skins, seeds, and stems, its antioxidant and antidiabetic effects were studied. Because hypertension and diabetes are related to a stage of inflammation and increased oxidative stress.

It has been estimated the world production of grape pomace to be 11.1 million tons (OIV, 2019). The composition of grape pomace is affected by many factors affect the composition of the grape itself and the method of processing the grape. Grape pomace contains high concentrations of lipids, protein, dietary fibers, and total phenolic compounds. Therefore, many efforts have been devoted to the use of grape pomace powders in the production of many products (Fruhbauerova *et al.*, 2020 Garcia-Lomillo & Gonzalez-Sanjose, 2017) and to overcome the environmental problems associated with milk their disposal.

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Antioxidants work to bind to free radicals and thus prevent the damage resulting from those radicals, which includes health problems such as heart disease, diabetes, and cancer. Phenolic compounds (secondary compounds produced by plants are substances that have strong antioxidant activity, as they work to bind to free radicals and electron donors). Or hydrogen and bonding to metals preventing fat oxidation, preventing DNA damage, etc. (Velez *et al.*, 2023)

The objective of this study was to prepare a pomace powder of black grape pomace powder and evaluate its functional and chemical properties, investigate the supplementation effect of chocolate ice milk with dried black grape pomace (DBGP) on chemical, physical, and sensory attributes of chocolate ice milk and to observe the changes of chocolate ice milk quality throughout storage.

## MATERIALS AND METHODS

### Materials

Fresh buffalo milk obtained from the herd of the Faculty of Agriculture, Menoufia University, Shebin El-Kom, Egypt. The cream was obtained by separating fresh buffalo milk at the pilot plant of the Department of Dairy Science and Technology.

Stabilizer: Mecrol IC was obtained from Meer Corporation, North Bergen, NJ, USA. Sucrose and cocoa powder were obtained from local markets. Skim milk powder was obtained from Hoogwegt International BV, Arnhenn, Netherlands (fat: 1.25% maximum, lactose: 56% maximum, ash 8.2% maximum, moisture: 4% maximum, protein in MSNF: 34% At least).

### Preparation of dried black grape pomace (DBGP)

Black grape fruit was collected from a local market in Kafrel-sheikh City, Kafrel-sheikh Governorate, Egypt. The Grape was washed with distilled water, crushed, and juiced without adding water. The resultant mixtures were then filtered and the filtrates were gathered and centrifuged at 10000 rpm for 15 min (Carl Padberg Zentrifugenbau Gmbh 7630 Lahr/ Schwarzwald). After that, the obtained pomace was dried at 50±2°C for 18 hr. under vacuum (Nascimento *et al.*, 2018). The dried pomace was ground carefully to pass through an 80 mesh sieve (0.18 mm). Finally, the dried powder was packed in polyethylene bags and stored at -18°C in a deep freezer until used. The composition and Functional properties of dried black grape pomace are shown in Table (1).

**Table (1): Chemical compositions and functional properties of dried black grape pomace (DBGP).**

| Composition | Chemical composition(g/100g) |
|---|---|
| Moisture | 7.35 |
| Fat | 6.98 |
| Protein | 11.72 |
| Ash | 9.34 |
| Total carbohydrates | 64.61 |
| Dietary fiber | 58.16 |
| TPC (mg GAE /g) | 59.06 |
| Antioxidant activity (%) | 58.26 |
| Functional properties | |
| Bulk density (g/cm$^{3}$) | 0.54 |
| Water absorption capacity(g/g) | 4.64 |
| Swelling capacity (ml/g) | 9.1 |
| Oil absorption capacity(g/g) | 1.53 |
| Solubility (%) | 10.86 |

Each value in the table was the mean of three replicates.

## Manufacture of ice milk

The iced chocolate milk mixture was prepared according to the method of Khader *et al.* (1992) with the following composition: 4% fat, 13% nonfat milk solids, 15% sugar, 0.5% stabilizer, and 3% cocoa. The iced milk control treatment was performed as described above, while the other four iced milk treatments were fortified with 1.0, 2.0, 3.0, and 4.0% dried grape pomace. The iced milk-chocolate mixture was heated at 69°C for 30 minutes, then cooled, and then aged overnight at 4°C. All iced milk mixtures were frozen in an experimental iced milk freezer (Cattabriga, Boloniga, Italy). The resulting cooled milk is packed into plastic cups and kept in a deep freezer at -18°C for 24 hours. For hardening. Frozen milk was stored at -20°C +2 for 12 weeks. Samples from all frozen milk treatments were analyzed when fresh (zero times) and every two weeks for physicochemical properties and sensory evaluation. The entire experiment was performed in triplicate.

## Functional properties determination

Bulk Density: Bulk density is the ratio of the mass of samples to the volume of their container. It was measured by (Mohsenin, 1986 and Joshi *et al.*, 1993) by weighing a measuring cylinder filled with a known volume and calculated as follows:

$$P_b = \frac{M}{V}$$

*Where* $P_b$ is bulk density (g/cm$^3$), M is the mass (g) of the sample and V is the volume of the sample.

Water absorption capacity, Oil absorption capacity, and Swelling capacity were determined according to (Robertson *et al.*, 2000). Solubility was estimated as described by (Mepha *et al.*, 2007).

## Physical and chemical analysis

Overrun of the ice milk was determined according to the method described by Marshall *et al*. (2003). The specific gravity of the ice milk mixture and ice milk samples was determined as described by El-darshan (2019). Weight per gallon of ice milk mixture and ice milk in kilogram (kg) were directly calculated according to Arbuckle (1986) by multiplying the specific gravity by the factor 3.7863. The melting resistance of ice milk was determined as described by El-Dahshan (2019).

## Chemical analysis

pH values, titratable acidity, and fat content in ice milk were determined according to Ling (1963). Total solids, ash, fat in BGPP, total protein, and dietary fiber were determined according to the methods described by A. O.A. C. (2010). Carbohydrate was calculated according to the following equation:

$$\text{Carbohydrate \%} = \text{Total solids(\%)} - [\text{Fat (\%)} + \text{Protein (\%)} + \text{Ash (\%)}]$$

The total phenolic content of grape pomace powder and ice milk samples was determined by the Folin-Ciocaltue micro-method according to Allam *et al.* (2015). Antioxidant activity: Ferric reducing power of grape pomace powder and ice milk samples was assessed according to Luo *et al.* (2014).

## Sensory evaluation

A taste survey was conducted of a number of faculty members in the Department of Dairy Sciences at the Faculty of Agriculture, Menoufia University, and the Department of Science at the Animal Production Research Station in Sakha. The sensory characteristics of each batch of iced chocolate milk were determined at time zero and every two weeks of the storage period according to the classification sheets described by Kibari and Hussein (1997).

## Statistical analysis

Data were analyzed using a randomized complete block design and a 2×3 factorial design. Newman Keels. A multiple comparison test (Steel and Torrie, 1980) was used using

CoStat software. Statistically significant differences were determined at p ≥0.05.

## RESULTS AND DISCUSSIONS

### Properties of ice milk mix

The specific gravity and weight per gallon of mixed chocolate ice milk made with different ratios of dried black grape pomace (DBGP) are shown in (Table 2). The data indicated that the specific gravity and weight per gallon of chocolate ice milk increased by increasing the amount of DBGP. These results may be due to the increased total solids of the iced chocolate milk mixture (Hamed *et al.*, 2014 and Kebary *et al.*, 2018). The chocolate milk iced mixture made with the largest amount of dried black grape pomace showed the highest weight and specificity per gallon, there were significant differences (at P ≥ 0.05) from the other chocolate milk iced mixtures, (Table 2).

**Table (2). Impact of supplementing chocolate ice milk with dried black grape pomace on some properties of ice milk mix.**

| Ice milk treatments | Specific gravity | Weight per gallon | Acidity | pH value |
|---|---|---|---|---|
| C | $1.1732^{E}$ | $4.4416^{E}$ | $0.24^{A}$ | $6.76^{A}$ |
| $T_1$ | $1.1936^{D}$ | $4.5189^{D}$ | $0.24^{A}$ | $6.72^{A}$ |
| $T_2$ | $1.2121^{C}$ | $4.5890^{C}$ | $0.27^{A}$ | $6.75^{A}$ |
| $T_3$ | $1.2506^{B}$ | $4.7346^{B}$ | $0.26^{A}$ | $6.80^{A}$ |
| $T_4$ | $1.3987^{A}$ | $5.2953^{A}$ | $0.26^{A}$ | $6.77^{A}$ |

Each value in the table was the mean of three replicates.

For each same letter in the same column there were non-significant differences at 0.05 level (p ≤ 0.05).

C: Control, chocolate ice milk without any additives.

$T_1$, $T_2$, $T_3$, and $T_4$: chocolate ice mix treatments made by adding 1,2,3, and 4% of dried black grape pomace.

Table (2) shows the pH values and titratable acidity of the chocolate ice milk mixture. The results obtained showed that there were no significant differences (P>0.05) between the iced milk mixture, which means that adding dried black grape pomace (DBGP) to the iced chocolate milk mixture had no significant effect (P>0.05) on the titratable acidity and degree of Acidity. Of iced milk mixture with chocolate (Table 2).

### Properties of chocolate ice milk

The overrun is evident from the data presented in Table (3). The iced milk treatment (T1) performed with the addition of 1% DBGP showed the highest overshoot and was significantly different (at P ≥0.05) from the other treatments (Table 3). No significant differences were observed between the control and T2 each other, which means that adding dried black grape pomace up to 2.0% did not have a significant effect (P>0.05) on the excess of the resulting chocolate iced milk, with an increase in the amount of additives. Dried black grape pomace greater than 2.0% caused a gradual decrease (P ≥0.05) in the overflow of iced chocolate milk (Table 3). This decrease in overflow may be due to increased viscosity (Fuentes-Alventosa *et al.*, 2009 and Elleuch *et al.,* 2011), which subsequently suppress the ability of chocolate ice milk to retain air (Chang & Hartel, 2002; Sofjan & Hartel, 2004 and Meyer *et al.*, 2011).

The specific gravity and weight per gallon of iced chocolate milk are shown in Table 3.

Specific gravity and weight per gallon were gradually increased ($P<0.05$) by increasing the rate of addition of iced chocolate milk to BGPP. The T4 treatment performed by adding the highest amount (4%) of black grape pomace powder showed the highest gravity and specific weight per gallon and was significantly different from that of other iced chocolate milks (Table 3). These results may be due to increased total solids and/or decreased bypass in the resulting chocolate iced milk, as there is a negative correlation between specific gravity, weight per gallon, and bypass (Hamed *et al.*, 2014; Kebary *et al.*, 2015; Kamaly *et al*., 2017 and Kebary *et al*., 2018).

The melting resistance of chocolate ice milk that was expressed as the rate of melting shown in Table (3) illustrated the effect of different ratios of dried black grape pomace on chocolate ice milk. Supplementing chocolate ice milk with dried black grape pomace caused a gradual ($p\leq0.05$) reduction of the rate of melting by increasing the rate of supplementation which means increasing the melting resistance of the resultant chocolate ice milk at 60 min and the next 30 min (Table 3). These results may probably due to the higher dietary fiber content of dried black grape pomace (Dervisoglu & Yazici, 2006; Temiz & Yesilsu, 2010; Crizel *et al.*, 2014 and Hamed *et al.*, 2014) that increase the viscosity and the water holding capacity (Fuentes-Alventosa *et al*., 2009; Elleuch *et al.*, 2011; Baddi, 2012 and Akbari *et al.*, 2016). This binds a greater amount of water and leaves a smaller amount of free water that can dissolve faster than the bound water, thus increasing resistance to dissolution. (Temiz and Yesilsu, 2010; Akalin *et al*., 2017; Kamaly *et al.*, 2017 and Kebary *et al*., 2018). On the other hand, the melting resistance of all chocolate ice milk treatments after the last 30 min decreased significantly ($p \leq 0.05$) and this reduction increased by increasing the rate of adding dried black grape pomace (Table 3) (Kebary *et al*., 2015; Kamaly *et al.*, 2017 and Kebary *et al.*, 2018).

**Table (3). Some properties of chocolate ice milk supplemented with dried black grape pomace.**

| Ice milk treatments* | Specific gravity | Weight per gallon | Overrun% | Melting resistance | | |
|---|---|---|---|---|---|---|
| | | | | First 60 min | Next 30min | Last30min |
| C | $0.7902^{E}$ | $2.9916^{E}$ | $69.05^{B}$ | $39.4^{A}$ | $40.5^{A}$ | $20.1^{E}$ |
| $T_1$ | $0.8213^{D}$ | $3.1094^{D}$ | $69.56^{A}$ | $38.6^{AB}$ | $39.6^{B}$ | $21.8^{D}$ |
| $T_2$ | $0.8271^{C}$ | $3.1313^{C}$ | $68.98^{B}$ | $36.7^{B}$ | $38.4^{C}$ | $24.9^{C}$ |
| $T_3$ | $0.8502^{B}$ | $3.2188^{B}$ | $67.07^{C}$ | $33.2^{C}$ | $35.1^{D}$ | $31.7^{B}$ |
| $T_4$ | $0.8762^{A}$ | $3.3172^{A}$ | $63.24^{D}$ | $31.8^{D}$ | $33.2^{E}$ | $35.0^{A}$ |

* See to Table (2).

All chocolate iced milk treatments were not significantly different ($P>0.05$) from each other in pH value, titratable acidity, and fat content which means that supplementation of chocolate iced milk with DBGP did not have a significant effect on pH value, titratable acidity and fat. Content of chocolate iced milk treats (Table 4). The pH, titratable acidity, and fat value of all frozen milk treatments did not change significantly throughout the storage period ($P > 0.05$) (Hamed *et al.*, 2014; Kamaly *et al.*, 2017; Kebary *et al.*, 2018 and El-Dahshan, 2019).

**Table (4). pH value, titratable acidity, and fat content of chocolate ice milk supplemented with dried black grape pomace.**

| **Titratable acidity (%)** | | | | | |
|---|---|---|---|---|---|
| **Ice milk treatment** | **Storage period -18°C** | | | | **Mean*** |
| | **Fresh** | **4weeks** | **8weeks** | **12weeks** | |
| C | 0.25 | 0.26 | 0.26 | 0.27 | $0.260^{A}$ |
| $T_1$ | 0.25 | 0.25 | 0.26 | 0.26 | $0.255^{A}$ |
| $T_2$ | 0.26 | 0.27 | 0.27 | 0.28 | $0.270^{A}$ |
| $T_3$ | 0.25 | 0.26 | 0.27 | 0.28 | $0.265^{A}$ |
| $T_4$ | 0.27 | 0.28 | 0.27 | 0.27 | $0.272^{A}$ |
| Mean* | $0.256^{a}$ | $0.264^{a}$ | $0.266^{a}$ | $0.272^{a}$ | |
| **pH value** | | | | | |
| Ice milk treatment | Storage period at -18°C | | | | Mean* |
| | Fresh | 4weeks | 8weeks | 12weeks | |
| C | 6.64 | 6.78 | 6.63 | 6.62 | $6.67^{A}$ |
| $T_1$ | 6.67 | 6.66 | 6.64 | 6.64 | $6.65^{A}$ |
| $T_2$ | 6.68 | 6.65 | 6.66 | 6.65 | $6.66^{A}$ |
| $T_3$ | 6.71 | 6.69 | 6.70 | 6.64 | $6.69^{A}$ |
| $T_4$ | 6.68 | 6.65 | 6.66 | 6.63 | $6.66^{A}$ |
| Mean* | $6.68^{a}$ | $6.69^{a}$ | $6.66^{a}$ | $6.64^{a}$ | |
| **Fat content (%)** | | | | | |
| **Ice milk treatment** | **Storage period at -18°C** | | | | **Mean*** |
| | **Fresh** | **4weeks** | **8weeks** | **12weeks** | |
| C | 4.5 | 4.5 | 4.6 | 4.6 | $4.55^{A}$ |
| $T_1$ | 4.6 | 4.5 | 4.7 | 4.7 | $4.63^{A}$ |
| $T_2$ | 4.6 | 4.6 | 4.5 | 4.7 | $4.63^{A}$ |
| $T_3$ | 4.7 | 4.8 | 4.6 | 4.6 | $4.68^{A}$ |
| $T_4$ | 4.6 | 4.6 | 4.8 | 4.8 | $4.70^{A}$ |
| Mean* | $4.6^{a}$ | $4.6^{a}$ | $4.66^{a}$ | $4.68^{a}$ | |

C: Control chocolate ice milk without black grape pomace powder.
$T_1$, $T_2$, $T_3$ and $T_4$ chocolate ice milk treatments made by adding 1, 2, 3 and 4% dried black grape pomace, respectively.
Means* with different small superscripts in the same row means the treatments are different during storage period, while means with different capital superscripts in the same columns means the treatments are significantly different at significant level 0.05

Total solids, total protein and ash contents of chocolate ice milk treatments made with DBGP increased significantly ($p \leq 0.05$) (Table 5) by adding DBGP. (Abdullah *et al.*, 2003; Soukoulis *et al.*, 2009; Hamed *et al.*, 2014; Ayar *et al.*, 2018 and Subhashini *et al.*, 2018). On the other hand, total solids, total protein and ash contents of all chocolate ice milk treatments did not change significantly ($p > 0.05$) during the storage period (Table 5). Similar trends were reported by Hamed *et al.* (2014), Kamaly *et al.* (2017), Kebary *et al*. (2018) and El-Dahshan (2019).

**Table (5). Total solids, total protein and ash contents (%) of chocolate ice milk supplemented with dried black grape pomace.**

| **Total solids content** | | | | | |
|---|---|---|---|---|---|
| **Ice milk treatment**** | **Storage period at -18°C** | | | | **Mean*** |
| | **Fresh** | **4weeks** | **8weeks** | **12weeks** | |
| C | 33.83 | 33.72 | 33.86 | 33.92 | $33.83^{D}$ |
| $T_1$ | 34.56 | 34.61 | 34.68 | 34.66 | $34.63^{CD}$ |
| $T_2$ | 35.43 | 35.48 | 35.53 | 35.66 | $35.53^{BC}$ |
| $T_3$ | 36.28 | 36.35 | 36.46 | 36.45 | $36.39^{AB}$ |
| $T_4$ | 37.32 | 37.46 | 37.83 | 37.79 | $37.60^{A}$ |
| Mean* | $35.48^{a}$ | $35.52^{a}$ | $35.67^{a}$ | $35.70^{a}$ | |
| Protein content | | | | | |
| **Ice milk treatment**** | **Storage period at -18°C** | | | | **Mean*** |
| | **Fresh** | **4weeks** | **8weeks** | **12weeks** | |
| C | 5.78 | 5.65 | 5.53 | 5.55 | $5.63^{B}$ |
| $T_1$ | 5.91 | 5.78 | 5.62 | 5.59 | $5.73^{AB}$ |
| $T_2$ | 5.99 | 5.86 | 5.71 | 5.65 | $5.80^{AB}$ |
| $T_3$ | 6.05 | 5.92 | 5.80 | 5.71 | $5.87^{AB}$ |
| $T_4$ | 6.23 | 6.10 | 5.98 | 5.99 | $6.09^{A}$ |
| Mean* | $5.99^{a}$ | $5.86^{a}$ | $5.73^{a}$ | $5.69^{a}$ | |
| Ash content | | | | | |
| **Ice milk treatment**** | **Storage period at -18°C** | | | | **Mean*** |
| | **Fresh** | **4weeks** | **8weeks** | **12weeks** | |
| C | 1.38 | 1.36 | 1.38 | 1.33 | $1.36^{E}$ |
| $T_1$ | 1.43 | 1.38 | 1.37 | 1.35 | $1.38^{D}$ |
| $T_2$ | 1.48 | 1.41 | 1.45 | 1.39 | $1.43^{C}$ |
| $T_3$ | 1.56 | 1.49 | 1.42 | 1.43 | $1.47^{B}$ |
| $T_4$ | 1.62 | 1.58 | 1.53 | 1.49 | $1.55^{A}$ |
| Mean* | $1.49^{a}$ | $1.44^{a}$ | $1.43^{a}$ | $1.39^{a}$ | |

* See to Table (4).

Supplementation of chocolate ice milk with DBGP caused a gradual increase ($p \leq 0.05$) of the dietary fibers content of chocolate ice milk by increasing the rate of supplementation, which could be attributed to the higher dietary fibers content in DBGP Fig. (1) (Balasundram *et al.*,2006; Fontana *et al.*, 2013 and Sousa *et al.*, 2014). The attained results are in agreement with those of Hamed *et al.* (2014); Kamaly *et al.* (2017); Kebary *et al.* (2018); Nascimento *et al.* (2018) and Subhashini *et al.* (2018). On the other hand, the storage of chocolate ice milk did not affect significantly ($p > 0.05$) the dietary fiber content of all chocolate ice milk treatments (Kozlowicz *et al.*, 2019).

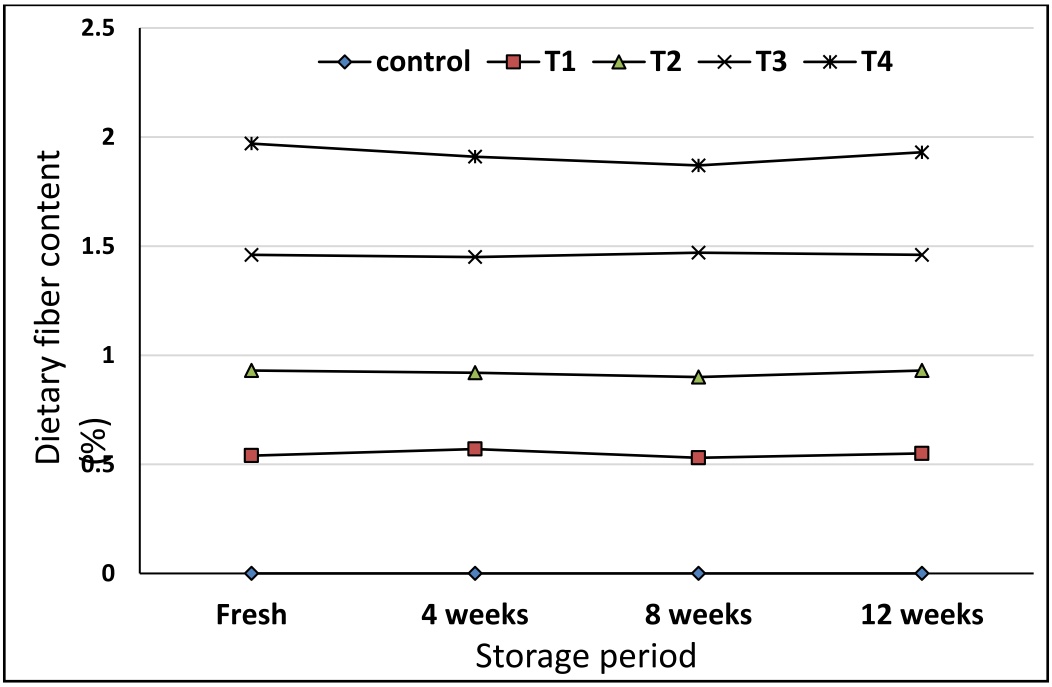


**Fig. (1). Dietary fiber content of chocolate ice milk supplemented with dried black grape pomace.**

Total phenolic compound contents expressed as (mg gallic acid/g) and antioxidant activity (%) of functional chocolate ice milk supplemented with DBGP during storage periods are presented in Fig. (2 and 3). Supplementation of chocolate ice milk with DBGP caused an obvious increase ($p \leq 0.05$) of total phenolic compounds contents and antioxidant activity of chocolate ice milk treatments by increasing the rate of supplementation with DBGP which might be due to the higher total phenolic compounds of DBGP (Marchiani *et al.*, 2016; Vital *et al.*, 2018; Costa *et al.*, 2018; Lucera *et al.*, 2018; Nascimento *et al.*, 2018; Mammadova *et al.*, 2020; Akca & Akpinar 2021; Barbaccia *et al.*, 2021; Ratu *et al.*, 2023 and Saberi *et al.*, 2023). On the other hand, the total phenolic compound contents and antioxidant activity of chocolate ice milk treatments decreased significantly ($p \leq 0.05$) as the storage period advanced. The decrease of antioxidant activity might be due to oxygen-accelerated oxidation, leading to the decline of antioxidant activity as a result of removing the reactive oxygen species and/or the interaction of phenolic compounds with protein, which masked the antioxidant activity (Heinonen *et al.*, 1998 and Sagdic *et al.*, 2011). Arts *et al.* (2002) reported that the masking depends on both the type and amount of protein and bioactive compounds. Moser *et al.* (2017) and Vital *et al.* (2018) reported that storage negatively affects polyphenols and a slight decrease of the polyphenol content was noted after 40 days of storage, which was attributed to oxidation.

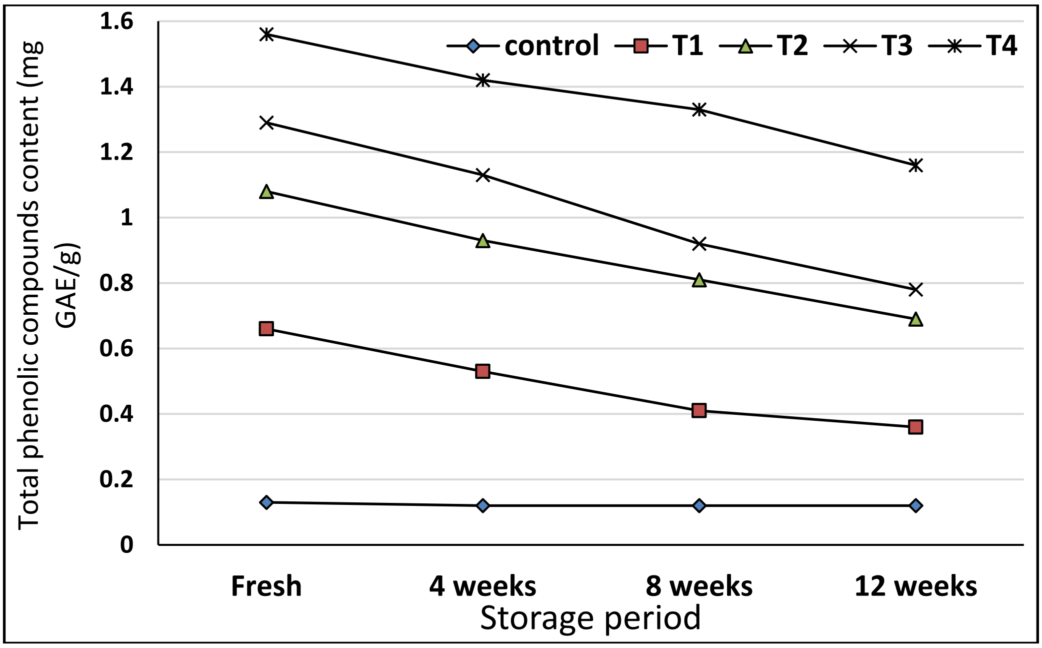


**Fig. (2). Total phenolic compounds (mg GAE/g) of chocolate ice milk supplemented with dried black grape pomace.**

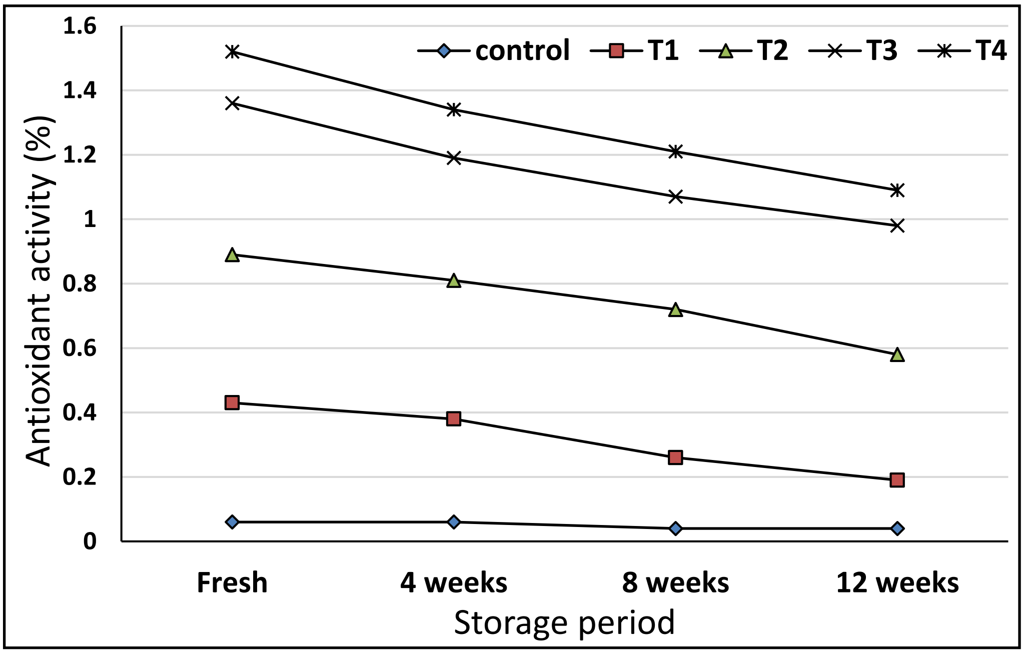


**Fig. (3). Antioxidant activity (%) of chocolate ice milk supplemented with dried black grape pomace.**

Flavor, body, texture, and overall scores followed similar trends (Table 6). There were no statistically significant differences ($P > 0.05$) between all chocolate iced milk treatments in terms of color grading and melting quality, meaning that the addition of dried black grape pomace had no significant effect ($P > 0.05$) on the color of the resulting iced milk. (Table 6).

The most acceptable chocolate milk ice treatments were T2 and T3 followed by T1 which was made by adding 2.0 and 3.0% DBGP followed by T1 (1%) dried black grape pomace. These treatments (T2 and T3) did not differ significantly from each other ($p > 0.05$), while they were significantly different ($p \geq 0.05$) from the other treatments (C and T4). These results indicate that supplementation of chocolate iced milk with dried black grape pomace up to 3% significantly improved the sensory properties of chocolate iced milk (Table 6). The score for sensory properties (flavor, colour, melting quality, body, texture, and overall score) did not change significantly ($P>0.05$) during the first six weeks of the storage period and then decreased during the last six weeks (Table 6). Overall, the low concentration of grape derivatives received the highest marks from the panelists. Ayyar *et al*. (2018) found that adding higher amounts of dietary fiber (4% w/w) from grapes had lower acceptability scores compared to adding 1% w/w, which had similar or slightly lower scores compared to control.

**Table (6). Impact of supplementing chocolate ice milk with dried black grape pomace on organoleptic properties.**

| Organoleptic properties | Storage period | Chocolate ice milk | | | | |
|---|---|---|---|---|---|---|
| | | **C** | **$T_1$** | **$T_2$** | **$T_3$** | **$T_4$** |
| Flavor (45) | Fresh | 42$^{BCa}$ | 42$^{Aa}$ | 42$^{Aa}$ | 42$^{Aa}$ | 40$^{Ca}$ |
| | 2 weeks | 42$^{BCa}$ | 41$^{Aa}$ | 41$^{Aa}$ | 42$^{Aa}$ | 40$^{Ca}$ |
| | 4 weeks | 41$^{BCa}$ | 41$^{Aa}$ | 40$^{Aa}$ | 40$^{Aa}$ | 40$^{Ca}$ |
| | 6 weeks | 40$^{BCa}$ | 40$^{Aa}$ | 38$^{Aa}$ | 40$^{Aa}$ | 38$^{Ca}$ |
| | 8 weeks | 38$^{BCb}$ | 38$^{Ab}$ | 37$^{Ab}$ | 38$^{Ab}$ | 36$^{Cb}$ |
| | 12 weeks | 35$^{BCc}$ | 36$^{Ac}$ | 35$^{Ac}$ | 36$^{Ac}$ | 34$^{Cc}$ |
| Body and texture(35) | Fresh | 30$^{Aa}$ | 30$^{Aa}$ | 33$^{Aa}$ | 31$^{Aa}$ | 30$^{Ba}$ |
| | 2 weeks | 30$^{Aa}$ | 30$^{Aa}$ | 31$^{Aa}$ | 30$^{Aa}$ | 30$^{Ba}$ |
| | 4 weeks | 30$^{Aa}$ | 29$^{Aa}$ | 30$^{Aa}$ | 31$^{Aa}$ | 28$^{Ba}$ |
| | 6 weeks | 29$^{Aa}$ | 28$^{Aa}$ | 29$^{Aa}$ | 28$^{Aa}$ | 27$^{Ba}$ |
| | 8 weeks | 27$^{Ab}$ | 27$^{Ab}$ | 27$^{Ab}$ | 28$^{Ab}$ | 26$^{Bb}$ |
| | 12 weeks | 27$^{Ac}$ | 27$^{Ac}$ | 26$^{Ac}$ | 26$^{Ac}$ | 24$^{Bc}$ |
| Melting quality(10) | Fresh | 8$^{Aa}$ | 9$^{Aa}$ | 9$^{Aa}$ | 9$^{Aa}$ | 9$^{Aa}$ |
| | 2 weeks | 8$^{Aa}$ | 8$^{Aa}$ | 8$^{Aa}$ | 8$^{Aa}$ | 8$^{Aa}$ |
| | 4 weeks | 8$^{Aa}$ | 8$^{Aa}$ | 8$^{Aa}$ | 8$^{Aa}$ | 7$^{Aa}$ |
| | 6 weeks | 7$^{Aa}$ | 6$^{Aa}$ | 7$^{Aa}$ | 7$^{Aa}$ | 7$^{Aa}$ |
| | 8 weeks | $^{Ab}$٧ | 5$^{Ab}$ | 6$^{Ab}$ | 7$^{Ab}$ | 7$^{Ab}$ |
| | 12 weeks | 7$^{Ac}$ | 5$^{Ac}$ | 5$^{Ac}$ | 6$^{Ac}$ | 6$^{Ac}$ |
| Color (10) | Fresh | 8$^{Aa}$ | 9$^{Aa}$ | 9$^{Aa}$ | 8$^{Aa}$ | 8$^{Aa}$ |
| | 2 weeks | 8$^{Aa}$ | 9$^{Aa}$ | 8$^{Aa}$ | 8$^{Aa}$ | 8$^{Aa}$ |
| | 4 weeks | 7$^{Aa}$ | $^{Aa}$٩ | 8$^{Aa}$ | 7$^{Aa}$ | 7$^{Aa}$ |
| | 6 weeks | 7$^{Aa}$ | 7$^{Aa}$ | $^{Aa}$٨ | 7$^{Aa}$ | 6$^{Aa}$ |
| | 8 weeks | 7$^{Ab}$ | 7$^{Ab}$ | 6$^{Ab}$ | 7$^{Ab}$ | 6$^{Ab}$ |
| | 12 weeks | 6$^{Ac}$ | 6$^{Ac}$ | 6$^{Ac}$ | 7$^{Ac}$ | 6$^{Ac}$ |
| Total score (100) | Fresh | 88$^{Ca}$ | 90$^{Ba}$ | 93$^{Aa}$ | 90$^{ABa}$ | 87$^{Da}$ |
| | 2 weeks | 88$^{Ca}$ | 88$^{Ba}$ | 88$^{Aa}$ | 88$^{ABa}$ | 86$^{Da}$ |
| | 4 weeks | 86$^{Ca}$ | 87$^{Ba}$ | 87$^{Aa}$ | 86$^{ABa}$ | 82$^{Da}$ |
| | 6 weeks | 83$^{Ca}$ | 80$^{Ba}$ | 84$^{Aa}$ | 82$^{ABa}$ | 78$^{Da}$ |
| | 8 weeks | 79$^{Cb}$ | 77$^{Bb}$ | 76$^{Ab}$ | 80$^{ABb}$ | 77$^{Db}$ |
| | 12 weeks | 75$^{Cc}$ | 74$^{Bc}$ | 72$^{Ac}$ | 75$^{ABc}$ | 70$^{Dc}$ |

C*: Control chocolate ice milk without black grape pomace powder.

$T_1$, $T_2$, $T_3$, and $T_4$ chocolate ice milk treatments are made by adding 1, 2, 3, and 4% black grape pomace powder, respectively.

Means** with different small superscripts in the same columns means the treatments are different during the storage period, while means with different capital superscripts in the same row means the treatments are significantly different at a significant level of 0.05.

It could be concluded that supplementation of chocolate ice milk with black grape pomace powder increased the melting resistance, specific gravity, weight per gallon, antioxidant activity, Dietary fiber, total phenolic compounds, total solids, protein, and ash of the resultant ice milk, while did not affect the fat content, titratable acidity and pH value. On the other hand, adding black grape pomace powder to ice milk up to 3.0% improved the acceptability of chocolate ice milk, where T2 and T3 were made by adding 2.0 and 3.0% black grape pomace powder were the most acceptable chocolate ice milk.

Therefore, the recommendation is that high-quality chocolate iced milk can be made by adding up to 3% black grape pomace powder without significant effects on the quality of chocolate iced milk.

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# جودة المثلوج اللبني بالشيكولاتة المدعم بتفل العنب الاسود

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## الملخص العربي

اهتم البحث بدراسة تاثير تدعيم المثلوج اللبني بالشيكولاتة بتفل العنب الاسود المجفف وذلك بنسب مختلفة علي بعض الخواص الكيميائية والفيزيائية والحسية للمثلوج اللبني, ولقد تم تصنيع ٥ معاملات وكانت معاملة الكنترول (بدون اضافة تفل العنب المجفف) اما المعاملات $T_1$ ، $T_2$ ، $T_3$ ، $T_4$ فقد تم بنسب اضافة ١ ، ٢ ، ٣ ، ٤% علي الترتيب وتم تخزين المعاملات في الفريزر ٢٠°م لمدة ١٢ اسبوع حيث اخذت عينات وهي طازجة وبعد ٢, ٤, ٦, ٨, ١٢ اسبوع وذلك لاجراء باقي التحليلات الكيماوية والحسية عليها.

**ولقد اوضحت النتائج المتحصل عليها بعد تحليلها احصائيا ما يلي:**

١- لم تختلف نسب الحموضة وpH لمخاليط المثلوج اللبني فى العينة الكنترول عن باقي العينات المضاف لها تفل العنب الاسود المجفف معنويا. مما يدل علي ان اضافة تفل العنب الاسود المجفف لم يؤثر علي حموضة وpH لمخلوط المثلوج اللبني.

٢- ادي اضافة تفل العنب الاسود المجفف الي زيادة ملحوظة فى الوزن النوعي والوزن بالجالون لمخاليط المثلوج اللبني وهذة الزيادة تتناسب طرديا مع معدل الاضافة

٣- حدث زيادة فى الريع للمثلوج اللبني حتي نسبة ٢% باضافة تفل العنب الاسود المجفف ولكن بزيادة النسبة فانة يقل الريع.

٤- ادي اضافة تفل العنب الاسود المجفف الي زيادة معنوية فى الوزن النوعي والوزن بالجالون للمثلوج اللبني بزيادة معدل الاضافة.

٥- ادى اضافة تفل العنب الاسود المجفف الي زيادة معنوية فى المقاومة للانصهار خلال ٩٠ دقيقة الاولي ثم قلت المقاومة للانصهار في اخر ٣٠ دقيقة من التقدير .

٦- لم تختلف نسب الحموضة وpH والدهن فى العينة الكنترول عن العينات الاخري المضاف اليها تفل العنب الاسود المجفف معنويا وهذا يدل علي ان اضافة تفل العنب الاسود المجفف لم يؤثر علي نسب الحموضة و pH والدهن ولم تختلف ايضا اثناء فترة التخزين .

٧- ادى اضافة تفل العنب الاسود المجفف للمثلوج اللبني الى زيادة الجوامد الكلية والبروتين الكلي والرماد معنويا وعلي الجانب الاخر لم تتغير نسب الجوامد الكلية والبروتين الكلي والرماد اثناء فترة التخزين.

٨- لم يتم اكتشاف الالياف الغذائية فى عينة الكنترول للمثلوج اللبني ولكن باضافة تفل العنب الاسود المجفف ادي الى زيادة الالياف الغذائية تتناسب طرديا مع معدل الاضافة.

٩- اضافة تفل العنب الاسود المجفف للمثلوج اللبني ادي الى زيادة اجمالي المركبات الفينولية ونشاط مضادات الاكسدة معنويا فى حين انم تم انخفاض كلا من اجمالي المركبات الفينولية ونشاط مضادات الاكسدة اثناء فترة التخزين.

١٠- اتخذت الخواص الحسية (النكهة، القوام والتركيب، المقاومة للانصهار، اللون، المجموع الكلي) نفس الاتجاهات تقريبا. فقد حصلت المعاملة $T_3$ المصنعة باضافة ٣% تفل العنب الاسود المجفف علي اعلي الدرجات. لم يحدث تغيير فى الدرجات الممنوحة لكل المعاملات معنويا اثناء ٦ اسابيع الاولي من التخزين ثم بدات فى الانخفاض حتي نهاية فترة التخزين.