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(Original Article)

Fortification of ice Milk with Purslane (*Portulaca oleracea*) Bioactive Compounds

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Abstract

The purslane ice milk was made with the addition of purslane extract at levels of 0.0, 0.1, 0.2, 0.3, and 0.4% for control, T1, T2, T3 and T4, respectively. Integrating purslane extract led to a significant decrease in density (from 0.725 to 0.652 g/cm3) as well as weight per gallon (from 6.05 to 5.44 lb.) in the resultant ice milk. On the other hand, the overrun percentage was increased from 41.20 to 58.90%. T4, which contained the greatest purslane extract (0.4%), gained the highest values of milting resistant after 10 and 50 minutes. Addition of purslane extract increased total solids, acidity, total nitrogen, and ash significantly), while pH and total carbohydrate% decreased. The radical scavenging activity (DPPH %), total phenolic content and total flavonoid content in purslane ice milk were increased from 24.74, 0.183 and 0.007 to 84.72,0.398 and 0.146, respectively. Microbiologically, the incorporation of purslane extract in purslane ice milk leads to a significant increase in total bacterial counts with an increase in purslane extract concentrations from 3.58 to 3.68cfu/g. The values of flavour scores had no significant difference among all treatments; however, the flavour score of purslane ice milk in all treatments was higher than control. the overall score of the treatment of purslane ice milk containing 0.4 % purslane extract had higher scores. In conclusion, the use of bioactive components of purslane extracts enhances and improves nutritional value, biological properties, functional properties and antioxidant activity as well as sensory evaluation of the resulting ice milk.

Keywords: *Ice milk, purslane extract, bioactive compound, antioxidant activity, Total phenolic, Flavonoid compound.*

Introduction

Among all age groups, milk and its products, especially ice cream, are the most popular and consumed foods. Although the majority of a consumer's nutritional demands are usually met by milk and milk products, sometimes we need to fortify milk or milk products with some natural phytochemical bioactive compounds. Milk and milk-derived products such as ice cream can be fortified with bio-active plant compounds such as natural antioxidants, flavonoids,

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phenolic compounds, and some mineral elements. With the introduction of fortified foods, there has been a global rise in health consciousness and interest in using herbs as desirable food additives in dairy and food products (Ansari and Kumar 2012). Recently, there has been an increase in interest among health-conscious consumers worldwide in utilizing the functional and therapeutic properties of herbs and spices to maintain and improve immunity, diet, and health, especially during the Covid-19 pandemic era (Paswan *et al*., 2021). Dairy products that are enhanced with natural bioactive sources, such as plant extracts are preferred over those that contain artificial colors, antioxidants, stabilizers, and preservatives. This makes it possible to provide consumers with natural and wholesome options (Bulut *et al*., 2021). Plant extracts' antioxidant characteristics not only shield the product from deterioration but also stop free radicals from acting on human cells, slowing down the ageing process(Stanislav *et al*., 2019). Rigla is the known name of purslane (*Portulaca oleracea* L.) in Egypt, is widely grown and has a long history of use in traditional medicine and food (Salman *et al*., 2020). Among all green leafy herbs, purslane likely possesses omega-3 fatty acid and alpha-linolenic acid in the highest concentration. Due to its helpful properties in preventing several ailments, it can be used as a healthy ingredient to enrich meals (Salehi *et al*., 2021).Purslane consider a rich source of phenolic acids, saponins, terpenoids, alkaloids, flavonoids, vitamins, and minerals(Kumar *et al*., 2021). Purslane possesses anti-inflammatory and antioxidant properties (Dkhil *et al*., 2011 and (Lee *et al*., 2012). Egyptian purslane species' leaves are rich in ash, protein, crude fibre, potassium, calcium, and magnesium Gabr et al., (2021).Purslane is regarded as a rich source of variable phytochemical bioactive components such as, α-Carotene (Dias *et al*., 2009), vitamin C (Viana *et al*., 2015), α-Tocopherol(Kamal Uddin *et al*., 2014), Glutathione (Alam *et al*., 2014), α-linolenic acid (Alam *et al*., 2014), Polysaccharides (YouGuo *et al*., 2009), Melatonin Hormones (Ren *et al*., 2011), and Polyphenols & flavonoids (Lim and Quah, 2007). This research aimed to utilize the bioactive components of purslane for enhance and improve the nutritional content, biological, and functional characteristics of ice milk as well as rise value-added of ice milk.

Materials and Methods

Materials

Fresh buffalo's milk (6.5% fat) was obtained from the Herd of Animal Production Department, Faculty of Agriculture, Al-Azhar University (Assiut Branch).Purslane was harvested from experimental station's plants, Faculty of Agriculture, Al-Azhar University (Assiut Branch).

Methods

Preparation of purslane extracts

Fresh purslane herb samples were sorted, washed with distilled water, and cut into pieces then dried in airy shadow place. The dried herb was grounded to a fine powder. Maceration was used to extract the sample powder with shaking at room temperature using 70% ethanol for 24 hours, at a ratio of 1:10 between the

herb powder and solvent. After that, until the extraction was finished, filtering and re-maceration were performed. The concentration of filtrate was carried out by using rotary evaporator under vacuum (Heidolph Rotary Evaporator, Germany) at 40 °C. Until it was used, the extract was kept in a refrigerator at 4 °C.

Manufacture of purslane ice milk

The mixes of low fat ice milk were prepared, as shown in Figure 1, to contain 12% SNF, 4% fat, 15% sugar, 0.3% CMC, and 0.1% vanillin, and then with the addition of purslane extracts as follows:

- Control: without purslane extract.
- T1: Contain purslane extract, 0.1% (w/w).
- T2: Contain purslane extract0.2% (w/w).
- 3: Contain purslane extract0.3% (w/w).
- T4: Contain purslane extract0.4% (w/w).

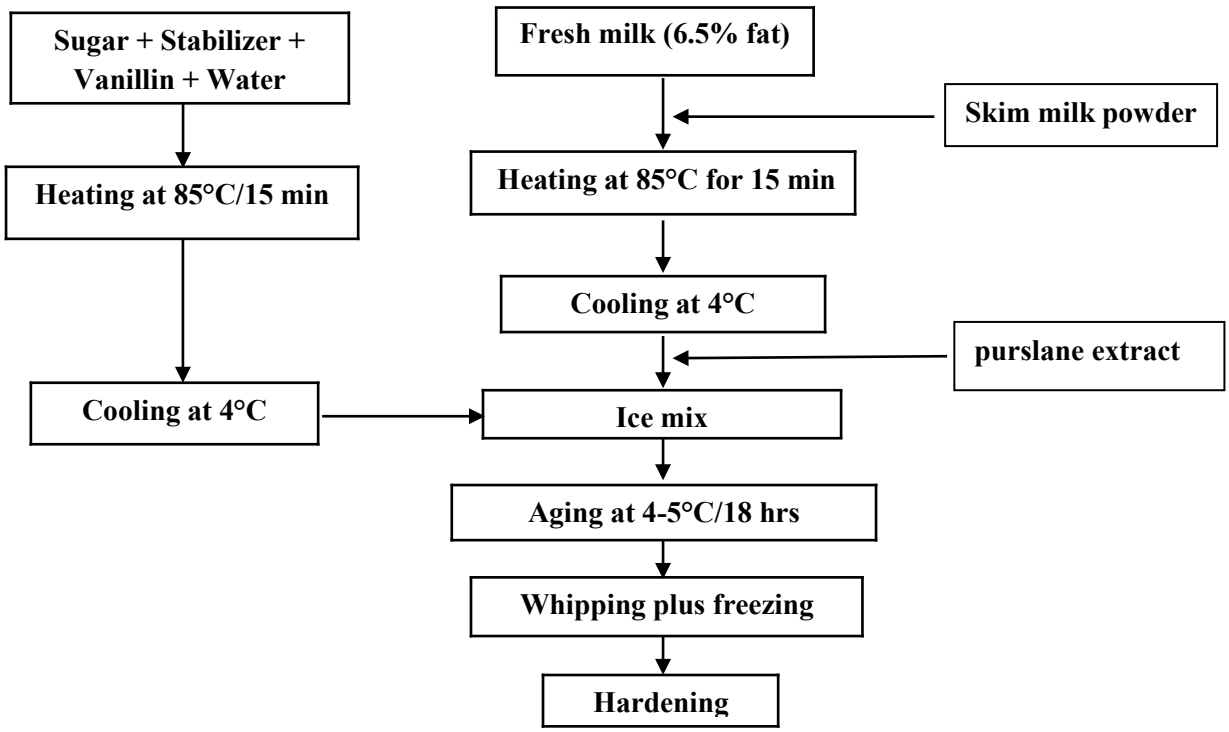

Fig 1. Diagram of the purslane Ice Milk production process

Physiochemical analysis

Total solids and titratable acidity were determined based on AOAC (2000). A pH meter (type 68 ESD 19713, USA) was used to test pH values. Fat contents were determined considering the method of Jacobs (1951). Total nitrogen content was estimated by the semi micro Kjeldahl (Gerhardt Type: VAP 200, Germany) as described by IDF (1993).Ash content was determined according to the method described by Kirk & Sawyer (1999).Total carbohydrate was determined by

difference method. Weight per gallon was determined according to Burke (1947). The relative viscosity and melting down were determined according to Arbuckle (1986). Overrun determined according to Sommer(1951).

Preparation of samples extracts

Extracts were prepared according to Karaman *et al*. (2014) Samples were extracted using 2 different solvent types [methanol: water (80:20 vol./ vol.) and acetone: water (80:20 vol/ vol)]. For the extraction process, 10 g of ice milk sample was weighed into a flask and 90 mL of extraction solvent was added. The mixture was stirred for 1 h on a magnetic stirrer at room temperature, and then kept in the dark for 24 h for effective extraction. After the extraction procedure, samples were centrifuged (UNI Equip, Germany) at 13,680 ×g for 10 min at room temperature. The supernatant was gathered and filtered through a 0.45-µm filter. The filtrate was used to measure the antioxidant compounds' activity.

Determination of antioxidant activity (DPPH Assay)

The free radical scavenging activity can be measured by using 2, 2-diphenyl-1-picryl-hydrazyl (DPPH) by the method of Cervato *et al*., (2000) with some modification. Briefly, an appropriate dilution of the extracts (1 ml) was mixed with 3 ml of a 0.1 mM methanolic solution of DPPH radicals (in triplicates). The mixture was then left in the dark for 30 minutes before the absorbance at 517 nm was measured on a spectrophotometer (Unico Spectrophotometer UV 2802, U.S.A.). The following equation was used to calculate the inhibition percentage (Inh. %):

$$\%\text{Inh.} = [(\text{Abs 517control} - \text{Abs 517sample}) \div \text{Abs 517control}] \times 100.$$

Determination of total phenolic content (TPC)

According to the Folin-Ciocalteu method described by Chan *et al*. (2007), the total phenol concentration of sample extracts was measured. A known dilution of extracts in the amount of 300 µl was poured into a test tube (in triplicates).1.5 ml of Folin–Ciocalteu reagent, which was diluted 10 times with distilled water, was mixed with 1.2 ml of Na2CO3 solution (7.5% w/v).The mixtures were shaken, and then allowed to stand for 30 min at ambient temperature before the absorbance was measured at 765 nm against a blank prepared by dispensing 300 µl of distilled water instead of sample extract. Using a calibration curve, the total phenolic content was expressed as mg of gallic acid equivalents (GAE)/g of material as follows:

$$Y = 106 \times \text{Absorbance} + 0.1163$$

Where, Y is the GAE (mg/g), (R2 = 0.9996).

Determination of total flavonoid contents (TFC)

According to Asha *et al*., (2010) the total flavonoid content was calculated using the aluminum chloride method. The following equation, which is based on the calibration curve, was used to express the total flavonoid concentration as

quercetin equivalent (QE) in mg/g of material: Y = 98.65 × Absorbance - 2.9297, R2 = 0.9987, where y is the quercetin concentration QE (mg/g).

Sensory evaluation

The organoleptic evaluation of resultant ice milk was assessed by a panel of 10 persons of staff members of the Dairy Department, Faculty of Agriculture, Al-Azhar University, according to the scheme described by Marshall and Arbuckle (1996).

Microbiological analyses

Total viable counts and Psychrotrophic bacterial count were enumerated according to Marshal (1992).Coliform bacteria and Moulds & Yeasts were enumerated according to IDF (1985a) and IDF (1985b) respectively.

Statistical analyses

The Statistical Analysis System (SAS) was used to do an Analysis of Variance (ANOVA) on the collected data at a 5% level of significance. The mean differences were separated using Least Significant Difference (LSD) and showed as means ± SE. Shapiro-Wilk's W test was done for the assumption of normality in which the test was in significant.

Table 1. Ingredients used to prepare purslane ice milk (100 kg mix)

Ingredients %	Control	Purslane extract (%)			
		0.1	0.2	0.3	0.4
Whole buffalos' milk	61.56	61.60	61.51	61.55	61.58
Skim milk powder	07.27	07.27	07.27	07.27	07.27
Purslane extract	00.00	00.10	00.20	00.30	00.40
Sugar	15.00	15.00	15.00	15.00	15.00
Stabilizer	00.30	00.30	00.30	00.30	00.30
Vanillin	00.10	00.10	00.10	00.10	00.10
Water	15.77	15.63	15.62	15.48	15.35
Total (kg)	100	100	100	100	100

Data is the mean, $n = 3$.

Results and Discussion

Chosen blend components of purslane ice milk

Data in Table 1, evident that the purslane extract was added with the ratios 0.0, 0.1, 0.2, 0.3 and 0.4% for control and other treatments. These additive ratios caused the water and whole buffalo milk addition ratios to change. However, when we mix the ratios of the additional extract, milk, and water, we see that the final ratio in all treatments is 77.33%.While the ratios of the other ice milk ingredients, such as sugar, stabilizer, vanillin, and skim milk powder, are the same in all treatments.

The data in (table 2) displays the physical characteristics of purslane ice milk mixes made with various purslane concentrations.

Features of the ice milk mix

On ice milk mixtures, measurements of relative viscosity, density, and weight per gallon were taken. According to the findings, adding more purslane to the mixture caused relative viscosities to significant increase ($p<0.05$). The same trend was found by Milani and koocheki (2011).

Table 2. The effect of purslane extracts concentrations on the relative viscosity, density, and weight per gallon of purslane ice mix

Components	Mean (%) ± SE				
	Control	T1	T2	T3	T4
The relative viscosity	3.76±0.020^{d}	4.49±0.043^{c}	4.60±0.038^{bc}	4.64±0.023^{b}	4.75±0.047^{a}
Density (g/cm3)	1.024±0.001^{b}	1.032±0.002^{a}	1.032±0.004^{a}	1.034±0.002^{a}	1.036±0.001^{a}
Weight per gallon (Ib)	8.54±0.007^{b}	8.60±0.017^{a}	8.61±0.030^{a}	8.62±0.012^{a}	8.64±0.009^{a}

Data is the mean ± SE, n = 3. Means with the same letter are not significantly different at $p \geq 0.05$ between columns.

Control: plain ice milk, T1: ice milk with 0.1% (w/w)purslane extract, T2: ice milk with 0.2%purslane extract, T3: ice milk with 0.3% purslane extract and T4: ice milk with 0.4% purslane extract.

Addition of purslane extracts to ice milk has a significant effect on density ($p<0.05$) with increasing additive ratio of purslane extract.

Regarding to the weight per gallon in pounds, the data observed that the weight per gallon of purslane ice milk mix in pounds was increase with increasing of purslane concentration, but it had minimal difference among treatments.

Table 3. The effect of purslane extracts concentrations on density, weight per gallon and overrun of purslane ice milk

Properties	Mean ± SE				
	Control	T1	T2	T3	T4
Density (g/cm^3)	0.725±0.003^{a}	0.677±0.006^{b}	0.660±0.006^{c}	0.656±0.006^{c}	0.652±0.001^{c}
Weight per gallon (Ib)	6.05±0.026^{a}	5.64±0.052^{b}	5.50±0.049^{c}	5.44±0.038^{c}	5.44±0.006^{c}
Overrun (%)	41.20±0.568^{c}	52.44±1.623^{b}	56.44±1.486^{a}	58.31±1.133^{a}	58.90±0.200^{a}

Data is the mean ± SE, n = 3. Means with the same letter are not significantly different at $p \geq 0.05$ between columns.

Characteristics of purslane ice milk

The properties of ice milk made with different levels of purslane extracts are illustrated in Table (3). The density, as well as weight per gallon of resultant ice milk, decreased significantly ($p<0.05$) with the increase of purslane extract levels. The density values decreased from 0.725±0.003 to 0.652±0.001g/cm3 as well as weight per gallon from6.05±0.026 to 5.44±0.006 lb.

Control: plain ice milk, T1: ice milk with 0.1% (w/w)purslane extract, T2: ice milk with 0.2%purslane extract, T3: ice milk with 0.3% purslane extract and T4: ice milk with 0.4% purslane extract.

From the results in Table (3), it was noted that the overrun of the resultant ice milk increased significantly ($p<0.05$) as a result of the addition of purslane extracts. The increase in overrun may be due to the effect of purslane extracts in reducing viscosity, as well as may be attributed to the ability of a purslane-containing ice milk mixture possess a high air retention capacity (Camelo-Silva *et al*., 2021).

Melting resistance

The melting down rate of purslane ice milk was described in Figure (2). The results showed that the melting percentage after 10 min for purslane treatments was 6.37, 6.40, 0.98, 6.73 and 6.32% for control, T1, T2, T3 and T4 respectively.

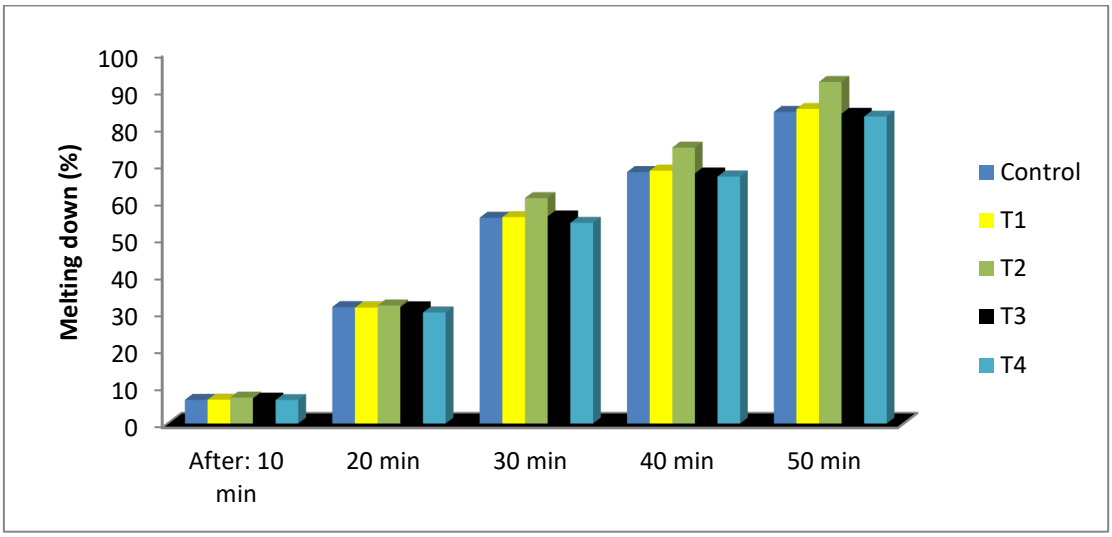

Figure 2. melting down% of purslane ice milk made by different ratio of purslane extract. Control: plain ice milk, T1: ice milkwith0.1% (w/w)purslane extract, T2:ice milkwith0.2%purslane extract, T3:ice milk with 0.3% purslane extract and T4: ice milk with 0.4% purslane extract.

While the milting down rate after 50 minutes for control, T1, T2, T3, and T4 are 83.93, 84.72, 92.00, 83.45, and 82.67, respectively. The highest values of milting resistant after 10 and 50 minutes were found in treatment 4, which contained 2% purslane extract. These findings concur with those reported by Dervisoglu (2006) and Milani and Koocheki (2011).

Chemical composition of purslane ice milk

The chemical composition of purslane ice milk with various purslane extract concentrations is shown in (Table 4).

The data in (table 4) showed that the addition of purslane extract impacted the total solids content of purslane ice milk. With increasing purslane extract

concentration, the total solids content of purslane ice milk increased significantly ($p<0.05$), which may be related to the high TS content. In addition, the control sample had lower values of total solids than that of purslane ice milk. Fat content in purslane ice milk was found to have a non-significant decrease ($p>0.05$) with increasing purslane extract addition. Moreover, the control samples contained higher values of fat, followed by T1 than the other treatments, due to the content of purslane extract.

Table 4. The effect of purslane extracts concentrations on the chemical composition of purslane ice milk

Components	Mean ± SE				
	Control	T1	T2	T3	T4
Total solids %	33.47±0.006^{e}	33.54±0.002^{d}	33.59±0.002^{c}	33.65±0.009^{b}	33.70±0.004^{a}
Fat %	4.10±0.058^{a}	4.10±0.003^{a}	4.08±0.10^{a}	4.08±0.012^{a}	4.07±0.010^{a}
Acidity %	0.15±0.003^{d}	0.16±0.003^{c}	0.17±0.000^{bc}	0.17±0.003^{ab}	0.18±1.96^{a}
pH	6.77±0.003^{e}	6.76±0.003^{d}	6.74±0.003^{c}	6.72±0.000^{b}	6.67±0.003^{a}
Total nitrogen %	0.91±0.004^{e}	0.94±0.005^{d}	0.99±0.002^{c}	1.04±0.004^{b}	1.09±0.002^{a}
Total carbohydrate %	22.49±0.040^{a}	22.33±0.045^{b}	22.07±0.047^{c}	21.79±0.56^{d}	21.52±0.049^{e}
Ash %	1.062±0.002^{e}	1.085±0.002^{d}	1.115±0.003^{c}	1.143±0.005^{b}	1.169±0.005^{a}

Data is the mean ± SE, n = 3. Means with the same letter are not significantly different at $p \geq 0.05$ between columns.

Control: plain ice milk, T1:ice milk with 0.1% (w/w)purslane extract, T2: ice milkwith 0.2%purslane extract, T3:ice milk with 0.3% purslane extract and T4:ice milk with 0.4% purslane extract.

Data in (Table 4) showed that the acidity values of purslane ice milk increased significantly ($p<0.05$) with an increase in purslane extract concentration. Additionally, the purslane ice milk exhibited higher acidity values than the control; this could be as a result of the acidic components that may be found in purslane extract. These outcomes align with what was reported by Tammam *et al* (2014) and Salman *et al*., (2020).

Results in (table 4) revealed that adding purslane extract changed the pH values of purslane ice milk. As the concentration of purslane extract increased, the pH values of the purslane ice milk declined. Additionally, the pH levels of the control samples were greater than those of the purslane ice milk. The same trend was obtained by Tammam *et al*., (2014) and Salman *et al*., (2020).

The data from (table 4) showed that, as the concentration of purslane extract increased, the total carbohydrates in the purslane ice milk decreased. This may be because purslane extract has a low level of carbohydrates. The same results were obtained by Noureldin, (2018).

The ash level of purslane ice milk considerably rose as the amount of purslane extract was raised. The ash content of the control was also lower than that of the purslane ice milk. This might occur as a result of the high mineral content of purslane extract. The identical outcomes were attained by Noureldin, (2018).

Evaluation of Antioxidant activity (DPPH %)

Epidemiological evidence has recently shown that a diet high in fruits and vegetables may lower the risk of chronic illnesses like obesity, diabetes, cardiovascular complications, and cancer. This effect has been attributed to the bioactive phytochemicals present in these foods, especially phenolic compounds, Aguilera *et al*., (2016).

Table 5.The effect of various purslane extract concentrations on the DPPH inhibition (%), total phenolic content (TPC), and total flavonoid content (TFC) of purslane ice milk

Compounds	Solvent types	Mean (%) ± SE				
		Control	T1	T2	T3	T4
DPPH Inhibition (%)	methanol	18.11±0.00^{e}	35.98±0.29^{d}	43.81±0.28^{c}	59.91±0.24^{b}	76.05±0.26^{a}
	acetone	24.74±0.60^{e}	36.28±0.35^{d}	51.80±0.35^{c}	69.15±0.41^{b}	84.72±0.13^{a}
TPC (mgGAE/g)	methanol	0.127±0.01^{d}	0.144±0.00^{d}	0.203±0.01^{c}	0.237±0.00^{b}	0.295±0.00^{a}
	acetone	0.183±0.00^{e}	0.213±0.01^{d}	0.284±0.01^{c}	0.368±0.01^{b}	0.398±0.00^{a}
TFC (mg QE /g)	methanol	0.028±0.00^{e}	0.060±0.00^{d}	0.099±0.00^{c}	0.111±0.00^{b}	0.132±0.00^{a}
	acetone	0.007±0.00^{e}	0.050±0.00^{d}	0.100±0.01^{c}	0.116±0.00^{b}	0.146±0.01^{a}

Data are the mean ± SE, n = 3. Means with the same letter are not significantly different at $p \geq 0.05$ between columns

Results in table 5 indicate that the radical scavenging activity (DPPH %) was carried out in two different solvents (methanol and acetone).The values of antioxidant scavenging activity (DPPH %) in purslane ice milk had a significant increase($p<0.05$) with the addition of purslane extract in both solvents, but samples that were extracted by acetone had higher values of antioxidant activity (DPPH) than those extracted by ethanol. In the same manner, it was reported by Salman *et al*., (2020) and Haghani *et al*., (2021). Also, from the data, samples of T4 that were extracted by acetone had 3.42 times more antioxidants than control samples that were extracted by the same solvent. That indicates purslane is considered a rich source of antioxidants.

Total phenolic content

Table 5illustrates the total phenolic content(mg GAE/g) of purslane ice milk. Adding natural components, like soy (Cornelia *et al*., 2022), kiwifruit (Sun-Waterhouse *et al*., 2013), blackthorn (Kavaz Yuksel 2015), grape seeds (Maier *et al*., 2009) and grape juice residue (Vital *et al*., 2018), enhanced the capability of total phenolic content. The total phenolic content increased gradually as the purslane extract concentration increased, with a significant difference ($p<0.05$).Moreover, the total phenolic content (mg GAE/g) in samples of purslane ice milk that were extracted with acetone had higher values than the samples that were extracted with ethanol. These outcomes are consistent with those found by Cornelia *et al*.,(2022).

Total flavonoid content

The same table shows the effect of purslane extract addition on the total flavonoid content (mg QE/g) of purslane ice milk. Total flavonoid content was significantly increased ($p<0.05$) in purslane ice milk samples which were extracted in ethanol and acetone solvent. But values obtained from samples extracted by acetone were slightly higher than those obtained by ethanol extraction. These outcomes matched those suggested by Bikheet *et al*., (2018).

Control: plain ice milk, T1: ice milk with 0.1% (w/w) purslane extract, T2:ice milk with 0.2%purslane extract, T3:ice milk with 0.3% purslane extract and T4:ice milk with 0.4% purslane extract.

Table 6. The effect of purslane extracts concentrations on the microbiological properties (Log cfu/ml) of purslane ice milk

Microbial type	Mean (%) ± SE				
	Control	T1	T2	T3	T4
Total bacterial count	3.58 ± 0.025^{c}	3.62 ± 0.020^{bc}	3.63 ± 0.018^{abc}	3.65 ± 0.007^{ab}	3.68 ± 0.017^{a}
Yeast and moulds count	ND*	ND*	ND*	ND*	ND*
Psychrotrophic bacteria	ND*	ND*	ND*	ND*	ND*
Coliform bacteria	ND*	ND*	ND*	ND*	ND*

Data are the mean ± SE, n = 3. Means with the same letter are not significantly different at $p \geq 0.05$ between columns.

Microbiological assessment

The result in Table 6 illustrates the microbiological assessment (total viable counts, yeast and moulds count, psychrotrophic bacteria count, and coliform bacteria count) of purslane ice milk. The data showed that the percentages of purslane extract that were present in the purslane ice milk had an impact on the total bacterial counts.

From the results presented in the same Table, it was observed that, total bacterial counts of purslane ice milk samples ranged from 3.58±0.025 to 3.68±0.017 log cfu/g. The incorporation of purslane extract in purslane ice milk leads to a significant increase($p<0.05$) in total bacterial counts with an increase in purslane extract concentrations. The changes in pH and titratable acidity (Table 4) are well correlated with these findings. These outcomes concur with those mentioned by Salman *et al*., (2020).

Control: plain ice milk, T1: ice milk with 0.1% (w/w) purslane extract, T2: ice milk with 0.2%purslane extract, T3: ice milk with 0.3% purslane extract and T4:ice milk with 0.4% purslane extract.

Regarding the yeast and mould count, psychrotrophic bacteria and coliform bacteria counts were not detected in any samples of purslane ice milk.

Organoleptic characteristics of ice milk with purslane

Ten dairy department staff scored the samples of purslane ice milk using the scoring sheet that was previously indicated in the methodology. Flavor was given 30 points, body & texture 30 points, melting quality 20 points and appearance 20 points.

Table 7. The effect of purslane extracts concentrations on the organoleptic properties of purslane ice milk

Components	Mean (%) ± SE				
	Control	T1	T2	T3	T4
Flavour	26.56±0.729^{a}	26.67±0.707^{a}	26.67±0.913^{a}	27.44±0.603^{a}	28.22±0.434^{a}
body and texture	26.11±0.455^{b}	26.67±0.707^{ab}	26.78±0.683^{ab}	27.00±0.601^{ab}	28.44±0.412^{a}
Melting quality	16.67±0.441^{b}	17.11±0.484^{ab}	17.22±0.619^{ab}	17.44±0.412^{ab}	18.33±0.236^{a}
Appearance	19.67±0.167^{a}	17.67±0.408^{b}	17.44±0.503^{bc}	16.56±0.530^{bc}	15.78±1.010^{cd}
Overall scour	89.01±1.519^{ab}	88.12±1.928^{b}	88.11±2.593^{b}	88.44±1.070^{b}	90.77±0.904^{a}

Data are the mean ± SE, n = 10. Means with the same letter are not significantly different at $p \geq 0.05$ between columns**.**

Data reported in (table 7) demonstrated that the addition of purslane extract to purslane ice milk had an impact on its organoleptic features, including flavour, body and texture, melting quality, and appearance. These characteristics represent a scoring summary for purslane ice milk samples made at various purslane extract concentrations.

The results revealed that the values of flavor score had no significant difference ($p>0.05$) among all treatments; however, the score of flavor in purslane ice milk in all treatments was higher than control. In addition, the treatments that have a level of purslane extract (0.4 %) gained a high score of flavor among the other purslane treatments.

The body and texture of purslane ice milk were affected by the addition of purslane extract, where body and texture had a significant increase ($p<0.05$) as the amount of purslane extract increased. Therefore, purslane treatment of ice milk scored higher than control in the body and texture categories.

Control: plain ice milk, T1: ice milk with 0.1% (w/w)purslane extract, T2:ice milk with 0.2%purslane extract, T3:ice milk with 0.3% purslane extract and T4:ice milk with 0.4% purslane extract.

The data in the same table showed that the ice milk made with purslane had better melting qualities than the control. Where, melting quality values of ice milk had a significant increase ($p<0.05$) with an addition of purslane extract. This indicated that the addition of purslane extract gives ice milk more softness. The treatment 4 that contained 0.4% purslane extract gained the highest score of melting quality, followed by the treatment that contained 0.3%, while control samples had the lowest score.

In relation to the overall score displayed in the same table, the T4 of purslane ice milk containing 0.4 % purslane extract had higher scores (90.77±0.904), followed by the control sample (89.01±1.519). On the other hand, the treatment containing 0.25% purslane extract had the lowest scores (88.11±2.593).

Conclusion

The use of bioactive components from purslane extracts enhanced and improved the nutritional content, biological characteristics, and functional characteristics of ice milk, as well as the sensory evaluation of the resultant ice milk. These findings indicated that purslane has promising ingredients for manufacturing ice milk at a level of 0.4% purslane extract. As a result, this could highlight the potential use of purslane as a low-cost, easily accessible functional food ingredient with antioxidant activity.

References

Aguilera, Y.; Martin-Cabrejas, M.A.; and Gonz´alez de Mejia, E. (2016). Phenolic compounds in fruits and beverages consumed as part of the mediterranean diet: Their role in prevention of chronic diseases. Phytochemistry Reviews 15(3): 405–423.

Alam, A.; Juraimi, A.; Rafii, M.; Hamid, A.; Uddin, K.; Alam, M. and Latif M. (2014). Genetic improvement of purslane (*Portulaca oleracea* L.) and its future prospects. Molecular Biology Reports 41: 7395-7411.

Ansari, M. M. and Kumar, D. S. (2012). Fortification of food and beverages with phytonutrients. Food and Public Health 2(6): 241-253.

AOAC. (2000). Association of Official Analytical Chemists. Official Methods of Analysis of Association of Official Agriculture Chemists. 17thed.Wisconsin: George Banta Co. Inc.

Arbuckle, W.S. (1986). Ice cream, IV, Ed. The Avi Pub. Co.; New York, USA, pp.: 40, 187, 207-212, 317-322 and 365.

Asha, K.; Sucheta, G.; Kavita, M.; Nirmala, D. and Jyoti, S. (2010). Quantification of phenolics and flavonoids by spectrophotometer from-Juglansregia. International Journal of Pharma and Bio Sciences 1(3).

Bikheet, M.M.; Abdel-Aleem, W.M.; and Khalil, O.S.F. (2018). Supplemented Ice Milk with Natural Bioactive Components from Roselle Calyces and Cinnamon Extracts. Journal of Food and Dairy Sciences 9(7): 229-235.

Bulut, M.; Tunçtürk, Y. and Alwazeer, D. (2021). Effect of fortification of set-type yoghurt with different plant extracts on its physicochemical, rheological, textural and sensory properties during storage. International Journal of Dairy Technology 74(4): 723-736.

Burke, A.D. (1947). Practical ice cream making. P.65 the Olsen pub. Co.; Milwaukee, Wisconsin, U.S.A, pp.: 65.

Camelo-Silva, C.; Barros, E.L.D.S.; Canella, M.H.M.; Verruck, S.; Prestes, A.A.; Vargas, M.O. and Prudêncio, E.S. (2021). Application of skimmed milk freeze

concentrated in production of ice cream: physical, chemical, structural and rheological properties. Food Science and Technology 42.

Cervato, G.; Carabelli, M.; Gervasio, S.; Cittera, A.; Cazzola, R. and Cestaro, B. (2000).Antioxbdant properties of oregano (*Origanum vulgare*) leaf extracts. Journal of Food Biochemistry 24(6): 453-465.

Chan, E. W. C.; Lim, Y. Y. and Chew, Y. L. (2007). Antioxidant activity of Camellia sinensis leaves and tea from a lowland plantation in Malaysia. Food chemistry 102(4): 1214-1222.

Cornelia, M.; Tunardy, A. M.; and Sinaga, W. S. (2022). The effect of cinnamon extract (*Cinnamomum burmanii* L.) addition towards the characteristics of soy milk ice cream. In 6th International Conference of Food, Agriculture, and Natural Resource (IC-FANRES 2021) (pp. 32-38). Atlantis Press.

Dervisoglu, M. (2006). Influence of hazelnut flour and skin addition on the physical, chemical and sensory properties of vanilla ice cream. International journal of food science & technology 41(6): 657-661.

Dias, M.; Camoes, M. and Oliveira, L. (2009). Carotenoids in traditional Portuguese fruits and vegetables. Food Chemistry 113: 808-815.

Dkhil A.; Moneim, A.; Al-Quraishy, S. and Saleh, R. (2011). Antioxidant effect of purslane (*Portulaca oleracea*) and its mechanism of action. Journal of Medicinal Plants Research 5(9): 1589-1593.

Gabr, G.; Hassan, H.; El Kashef, R.; Abd-Elhak, N. and Soliman, A. (2021). nutritional composition and bioactive compounds characterization of *Portulaca oleracea* L. leaves grown in Egypt. Fresenius environmental bulletin 30(6): 6313-6318.

Haghani, S.; Hadidi, M.; Pouramin, S.; Adinepour, F.; Hasiri, Z.; Moreno, A.; Munekata, P. E. S. and Lorenzo, J. M. (2021). Application of Cornelian Cherry (*Cornus mas* L.) Peel in Probiotic Ice Cream: Functionality and viability during storage. Antioxidants 10(11): 1777.

IDF (1985a). Milk and milk products. Enumeration of coliforms- colony counts technique and most probable number technique at 30°C. Int. Dairy Federation Standard 73A.

IDF (1985b). Milk and milk products. Detection and enumeration of yeasts and moulds. Int. Dairy Federation Standard 94A.

IDF (1993). Milk. Protein determination, determination of nitrogen content. Kjeldahl method and calculation of crude protein content. Standard 20B. Brussels: International Dairy Federation.

Jacobs, M. B. (1951). The chemical analysis of foods and food products. 2nd Ed. Pub. Van Nostr Co.; Inc.; USA.

Kamal Uddin, M. D.; Juraimi A.; Hossain M.; Na-har M. and Rahman M. (2014). Purslane weed (*Portulaca oleracea*): a prospective plant source of nutrition, omega-3 fatty acid, and an-tioxidant attributes. Scientific World J. 10: 95-119.

Karaman, S.; Toker, Ö. S.; Yüksel, F.; Çam, M.; Kayacier, A. and Dogan, M. (2014). Physicochemical, bioactive, and sensory properties of persimmon-based ice

cream: Technique for order preference by similarity to ideal solution to determine optimum concentration. Journal of dairy Science 97(1): 97-110.

KavazYuksel, A. (2015). The Effects of Blackthorn (*Prunus spinosa* L.) Addition on certain quality characteristics of ice cream. Journal of Food Quality 38(6): 413-421.

Kirk, S. and Sawyer, R. (1991). Pearson's composition and analysis of foods (No. Ed. 9). Longman Group Ltd.

Kumar, A.; Sreedharan, S.; Kashyap, A. K.; Singh, P. and Ramchiary, N. (2021). A review on bioactive phytochemicals and ethnopharmacological potential of purslane (*Portulaca oleracea* L.). Heliyon, e08669.

Lee, A.; Kim, J.; Lee, Y.; Kang, D. and Lee, H. (2012). Anti-TNF-α activity of *Portulaca oleracea* in vascular endothelial cells. International Journal of Molecular Sciences 13(5): 5628-5644

Lim, Y. and Quah, E. (2007). Antioxidant properties of different cultivars of *Portulaca oleracea*. Food Chemistry 103: 734-740.

Maier, T.; Schieber, A.; Kammerer, D.R.; and Carle, R. (2009). Residues of grape (*Vitis vinifera* L.) seed oil production as a valuable source of phenolic antioxidants. Food Chemistry 112(3): 551-559.

Marshall, R.T. and Arbuckle, W.S. (1996). Ice Cream. 5th Ed. Chapman & Hall, New York.

Milani, E. and Koocheki, A. (2011). The effects of date syrup and guar gum on physical, rheological and sensory properties of low fat frozen yoghurt dessert. International journal of dairy technology 64(1): 121-129.

Noureldin, H. A. (2018). Studies on fortifying milk and its products with mineral elements from natural resources. M.Sc. Thesis, Fac. Agric.; Al-Azhar Univ.

Paswan, V.K.; Rose, H.; Singh, C.S.; Yamini, S. and Rathaur, A. (2021). Herbs and Spices Fortified Functional Dairy Products. Herbs and Spices-New Processing Technologies.

Ren, S.; Weeda, S.; Akande, O.; Guo, Y.; Rutto, L. and Mebrahtu, T. (2011). Drought tolerance and AFLP based genetic diversity in purslane (*Portulaca oleracea* L.). J. of Biotech Research 3: 51- 61.

Salehi, M.; Sadeghi Mahoonak, A. and Khomeiri, M. (2021). Fortification of yogurt with Common purslane (*Portulaca oleracea*): evalution of its fatty acid profile and antioxidant properties. Journal of Food Processing and Preservation 13(4): 79-94.

Salman, K.H.; Mahmoud, E. A.; and Abd-Alla, A. A. (2020). Preparing Untraditional Kishk Formula with Purslane as Natural Source of Bioactive Compounds. Journal of Food and Dairy Sciences 11(11): 299-305.

Sommer, H.H. (1951):The theory and practice of ice cream making. 6th Ed.; Pub. by author, Madison, wis, USA.

Stanislav, S.; Lidiia, A.; Yuliya, G.; Andrey, L.; Elizaveta, P.; Irina, M.; Natalia, G.; and Aleksandr, R. (2019). Functional dairy products enriched with plant ingredients. Foods and Raw materials 7(2): 428-438.

Sun-Waterhouse, D.; Edmonds, L.; Wadhwa, S.S.; and Wibisono, R. (2013). Producing ice cream using a substantial amount of juice from kiwifruit with green, gold or red flesh. Food Research International 50(2): 647-656.

Tammam, A.A.; Salman, K. H.; and Abd-El-Rahim, A.M. (2014). Date syrup as a sugar substitute and natural flavour agent in ice cream manufacture. Journal of Food and Dairy Sciences 5(8): 625-632.

Viana, M.; Carlos, L.; Silva, E.; Pereira, S.; Oliveira, D. and Assis, M. (2015). Phytochemical composition and antioxidant potential of unconventional vegetables. Horticultura Brasileira, 33: 504-509.

Vital, A.C.P.; Santos, N.W.; Matumoto-Pintro, P.T.; da Silva Scapim, M.R.; and Madrona, G.S. (2018). Ice cream supplemented with grape juice residue as a source of antioxidants. International Journal of Dairy Technology 71(1): 183-189.

YouGuo, C.; ZongJi, S. and XiaoPing, C. (2009). Evaluation of free radicals scavenging and immunity-modulatory activities of Purslane polysaccharides. International J. of Biological Macromolecules 45: 448-452.

تدعيم المثلوج اللبني بمركبات الرجلة (*Portulaca oleracea*) النشطة بيولوجيًا

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الملخص

تم صنع مثلوج لبنى قليل الدهن بإضافة مستخلص الرجلة بمعدلات 0.0 ,0.1,0.2,0.3,0.4% للكنترول والمعاملات T1, T2 T3 , T4 على التوالي. أدى دمج مستخلص الرجلة في المثلوج اللبني إلى نقص معنوي في الكثافة (من0.725 إلى 0.652 جم / سم3) وكذلك الوزن لكل جالون (من6.05 إلى5.44رطل). كما زادت نسبة الريع من 41.20 إلى 58.90 %. اكتسبت المعاملة الرابعة والتي تحتوي 0.4% مستخلص رجلة أعلى قيم مقاومة الانصهار بعد 10 و50 دقيقة. كما أدى إضافة مستخلص الرجلة الى زيادة مضادات الأكسدة (DPPH%) والمحتوى الكلى للفينولات (ملجم GAE / جم) والمحتوى الكلى للفلافونويد (ملجم QE / جم) في المثلوج اللبني قليل الدسم من 24.74 ,0.007,0.183 إلى 84.72 ,0.398 ,0.146 على التوالي. ومن الناحية المكروبيولوجية، أدى دمج مستخلص الرجلة في المثلوج اللبني إلى زيادة العدد الكلى البكتيري زيادة معنوية ($p<0.05$) مع زيادة تركيز مستخلص الرجلة من 3.58 إلى 3.68 مستعمرة/جم. وفيما يخص التحكيم الحسي لم يكن لقيم النكهة والطعم فرق معنوي بين جميع المعاملات، إلا أنه حازت عينات المثلوج اللبني قليل الدسم المضاف اليها مستخلص الرجلة قيما أعلى في الطعم والنكهة من معاملة المقارنة (الكنترول). علاوة على ذلك حازت المعاملة الرابعة والتي تحتوي على 0.4% مستخلص رجلة على أعلى درجات التحكيم الكلى overall score بين جميع المعاملات. في الختام، تبين أن استخدام المكونات النشطة بيولوجيًا من مستخلصات الرجلة يعزز ويحسن القيمة الغذائية والخصائص البيولوجية والخصائص الوظيفية والنشاط المضاد للأكسدة وكذلك التقييم الحسي للمثلوج اللبني الناتج.