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Quality Parameters and Antioxidant Activity, Phenolic Compounds, Sensory Properties of Functional Yogurt with Melon (*Cucumis melo* L.) Peel Powder

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A R T I C L E I N F O

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A B S T R A C T

In the current study, four different types of yogurt were produced as control samples (no MPP added) and 1, 2, and 3% melon peel powder (MPP1, MPP2, and MPP3). These yogurts were determined by physicochemical, microbiological, sensory, total phenolic, and antioxidant activity weekly for 21 days. While ash, moisture, titratable acidity (TA), viscosity, water holding capacity (WHC), *a** and *b** values, total phenolic content (TPC), and antioxidant capacity of melon peel powder samples increased, *L**, pH, and syneresis values decreased. In concentrations of 1, 2, and 3%, the mean antioxidant activity of powdered yogurt was found to have average values during storage of 30.09%, 32.32%, and 36.26%, respectively. All yogurts continued to contain more than 10^7 cfu/g of live lactic acid bacteria during fermentation. As the storage time increased, the sample's pH and syneresis decreased, while titration acidity and texture increased. No yeast or mold (2 log cfu/g) was determined in the samples. The panelists preferred MPP1 and MPP2 samples. According to the findings of the study, melon rind powder, which is a by-product, can be recommended as a functional food additive in yogurts.

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Introduction

The food business and the food service market are now attractive, high-income areas with significant investments. However, some businesses stand out with the amount of waste they create after production (Rolim et al., 2020). According to estimates, more than one-third of the world's food was wasted in 2022, and about 98 million tons of food were squandered in 2023 as of June 30. Furthermore, the direct economic repercussions of food waste amount to around $750 billion per year, excluding fish and shellfish (The World Counts, 2024; Rațu et al., 2023). Fruits and vegetables that have been processed yield waste materials like fiber and byproducts like peel and seeds (da Silva and Jorge, 2014; Mallek-Ayadi et al., 2017). Fruit peels contain many bioactive substances, and recovering them might be profitable. Goulas and Manganaris (2012), the peel of most fruits contain higher concentrations of phenolic compounds and ascorbic acid than the pulp does (Mallek-Ayadi and Kechaou, 2017). Thus, from many aspects, including functional new product creation, environmental protection, and economic development, the evaluation of by-products is both essential and significant (Comunian et al., 2021; Dinkçi et al., 2021). Because it adapts to varied soil and temperature types, the melon (*Cucumis melo* L.), a member of the Cucurbitaceae family, is a widely consumed fruit of economic significance farmed around the world (Rolim et al., 2018). With the advancements in the food industry, wastes from melon fruit, a by-product of the fruit industry, are employed in the manufacturing of numerous items such as fruit juices, prepared salads, and snacks (Lucas-Torres et al., 2016; Gómez-García et al., 2020). Hence, the processing of melon peel, which is the source of many valuable natural components like pectin, limonene, flavonoids, polymethoxy flavones, and carotenoids, is studied in melon processing companies (Li et al., 2006; Raji et al., 2017). According to studies, eating melon and its byproducts can help prevent and treat certain diseases, including cancer and inflammation. It can also be used as a natural remedy for aging (Shofian et al., 2011; Rodríguez-Pérez et al., 2013; Gómez-García et al., 2020). Moreover, consumers' awareness of healthy nutrition has led to the addition of melon peel powder, which is rich in bioactive compounds, to yogurt production.

Previous studies have reported the use of melon peel in different ways, but its incorporation into yogurt has not been studied. It is thought that the melon peel will provide functionality to yogurt with the components it contains. Additionally, MPP yogurt production could create an alternative for the food market. Therefore, the physicochemical, microbiological, and sensory properties of yogurts produced by adding different concentrations of melon peel powder were investigated.

Materials and Methods

Materials

As a direct-to-vat system yogurt culture, *Streptococcus thermophilus* and *Lactobacillus delbrueckii* spp. *bulgaricus*, YC350 brand (Chr. Hansen-Peyma, Istanbul, Turkey) were employed. In the production, cow milk and fresh melon fruits (*Cucumis melo* L. var. *reticulatus*) from the region of Erzincan were used.

Preparation of Melon Peel Powder

Melon rinds (5 kg) were first washed, shredded, and then peeled with a stainless steel knife, and dehydrated in a domestic microwave oven (Arçelik KMF 833 l, Turkey) for 24 hours at 50 °C (Al-Sayed and Ahmed, 2013). A blender (Warning Commercial, USA) was used for grinding. To obtain uniform dimensions, these dried peels were ground in a food processor and put through 300 m sieves. Afterward, this powdered peel was concealed in hermetic bags at -18°C.

Chemical and Physical Composition of Cow Milk and Melon Peel Powder

The dry matter content of milk used in yogurt production was determined gravimetrically at 105±2 °C, the pH value was determined by a digital pH meter, the acidity value was determined by the titration method with 0.1 N NaOH, and the ash determination was determined gravimetrically at 550 °C.

Melon peel powder dry matter was measured according to the Association of Official Analytical Chemists (AOAC) method. In the ash analysis, the samples were analyzed by burning in a muffle furnace at 550 for 4 hours. The pH values were determined with a digital pH meter (Eutech PH 150 Model) by diluting the melon fiber with distilled water at a ratio of 1:10 (m:v) (Grigelmo-Miguel and Martoan-Belloso, 1998). Color analysis was performed using a color measurement device (Chroma Meter, CR-5, Konica Minolta, Osaka, Japan; Dirim and Çalışkan, 2012).

Total phenolic content was determined using the Folin-Ciocalteu method (Singleton et al., 1999). For this purpose, 1000 µg of the extracts were taken, and the total volume was made up to 25 mL. The mixture was vortexed by adding 0.5 mL of Folin-Ciocalteu's reagent and 1.5 mL of 2% Na_2CO_3 at 3 minute intervals. The absorbance of the samples kept at room temperature and in the dark for 30 min was determined at 760 nm with a UV-vis spectrophotometer (Shimadzu, UV mini-1240, Japan), and the total phenolic content was expressed as mg GAE/g using the curve prepared with gallic acid (R2= 0.982).

In the study, 2.95 mg DPPH (2,2-diphenyl-1-picrylhydrazyl) was weighed and transferred to a 50 mL balloon jug and DPPH solution was prepared by filling the balloon jug with methanol (Merck, Germany) to the line. For analysis, 200 µL of the prepared extracts were taken and transferred to test tubes. After adding 3 mL of freshly prepared DPPH solution and vortexing for 30 seconds, it was kept for 30 minutes in a dark environment at room temperature. After this time, the absorbance was read at 517 nm on a UV-vis spectrophotometer (Shimadzu, UV mini-1240, Japan; Ye et al., 2013).

$$\text{DPPH (\%)} = \left(\frac{1 - \text{Absorbance of sample}}{\text{Absorbance of control}}\right) \times 100$$

Manufacture of Yogurt Samples

In the yogurt production, with the aid of Ultra Turrax (Daihan Scientific, Co., Ltd.), milk and melon peel powder were combined. Later, the milk was heated (90°C for 10 min.) and then cooled (42°C). The milk was split into four equal pieces. Three parts were produced with melon peel powder at various concentrations of 1%, 2%, and 3% (MPP1, MPP2 and MPP3), and a control (C). In sterile plastic containers, starting cultures were used to incubate yogurts at a temperature of 42°C and analyzed during 21 days of storage. The images of trial yogurt samples are given in Figure 1.

Figure 1. The images of trial yogurt samples

Physical and Chemical Analysis

The method described by Kurt et al. (2007) was used to gravimetrically quantify the moisture, ash, and titration acidity values of melon peel powder. A pH meter (Eutech PH 150 Model) was used to determine the pH (AOAC, 1990). A viscometer with the Brookfield brand [model DV-1; Brookfield Engineering Laboratories, Inc., MA, USA); Gassem et al. 1991] was used to calculate the viscosity values. The serum separation and water-holding capacity were expressed using the techniques described by Delikanlı and Özcan (2014) and Remeuf et al. (2003) methods respectively.

Colour Measurement

The Hunter instrument (Colourflex-EZ, Hunterlab, Virginia, USA) was calibrated before the analysis began. The homogenized samples' L^*, a^*, and b^* color values were read (Cueva and Aryana, 2008). Using the following formulas, the saturation index (C^*), hue angle ($H°$), and total color difference (ΔE^*) were calculated (Kurtuldu and Özcan, 2018)

$$C^* = (a^{*2}+b^{*2})^{1/2}$$

$$H^0 = \tan^{-1}(b^*/a^*)$$

$$\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

Determination of Total Antioxidant Activity

The 2,2-diphenyl-1-picrylhydrazyl method was modified to assess the samples' capacity to scavenge (DPPH) radicals (Ye et al., 2013).

DPPH (%)=(1-Absorbance of sample/Absorbance of control) x 100

Total Phenolic Content Assay (TPC)

Total phenolic levels were determined spectrophotometrically using the Folin-Ciocalteu technique (Singleton and Rossi, 1965). 150 µL of sample extracts were combined with 600 mL of 7.5% (w/v) Na_2CO_3 and 750 µL of Folin Ciocalteu reagent. To measure the absorbance, a UV/visible spectrophotometer was used at 765 nm (Perkin-Elmer, USA). The results are expressed as g of gallic acid equivalent (GAE) per gram of yogurt sample.

Microbiological Analysis

Using a Stomacher (Interscience-Bagmixer 400 P, St. Nom, Fransa), 10 g of yogurt samples were diluted in 90 mL of a 0.85% (w/v) NaCl solution. The Harrigan (1998) approach was used to find the yeast and mold cells. The agar plates were kept at room temperature for 5-7 days of incubation. M17 agar was used to test the *S. thermophilus* cells under aerobic conditions. It was incubated at 35-37 °C for 24-48 h. Using MRS agar, *L. bulgaricus* cells were counted after it was cultured anaerobically for 72 hours at 37 °C (Vinderola and Reinheimer, 1999).

Sensory Evaluation

Eight panelists participated in the sensory evaluation, rating the samples' appearance, color, flavor, texture, and general acceptability on a scale from 1 to 9 (poor to outstanding) throughout the storage period (Bodyfelt et al., 1988).

Statistical Analysis

The SPSS (Version 22.00, SPSS, IBM, NY, USA) package program was used to conduct a variance analysis of the results.

Results and Discussion

Physicochemical of Cow Milk and Melon Peel Powders

Table 1 presents the findings of the physicochemical analysis of cow milk and melon peel powdered. Dry matter (8.85±0.21%), total antioxidant activity (13.15±1.82%), and total phenolics (2.59±0.09 mg GAE/g) made up the melon peel powder's composition. In a study, the total phenolic content of mazoon melon peel was found to be 332 mg/100 g extract (Mallek-Ayadi et al., 2017). The melon peel, however, was likely higher in phenolic compounds than the seeds and flesh (285 and 168 mg/100g respectively), according to İsmail et al. (2010). According to Al-Sayed and Ahmed (2013), four phenolic compounds, including 4-hydroxybenzoic acid, chlorogenic acid, coumaric acid, and vanillin, were found in sharlyn melon peels. These compounds ranged in concentration from 66.2 to 325.3 µ/g DW. The researchers also determined that the melon peel's free radical scavenging activity (DPPH) value was 12.53%. In a study, pH (6.63±0.01a), titration acidity (0.23±0.02), dry matter (11.7±0.28), ash (0.45±0.02), fat (3.05±0.07b), and protein (3.11±0.03) of cow milk were found (Nalbant and Yüceer, 2020).

pH, Titratable Acidity, and Microbiological Counts

Table 2 lists the physicochemical characteristics of the samples. The treatments had a substantial impact on these characteristics ($p<0.05$). The lowest (1.038±0.004) and maximum (1.204±0.004) acidity values were found in the C and MPP3 samples, respectively. Melon peel powder raised the acidity values of yogurts. According to Wang et al. (2019), the added apple fiber did not significantly affect the titratable acidity values of set-type yogurts throughout the 28 days (up to only 0.15%). Perez-Chabela et al. (2021), yogurt samples made with mango peel flour exhibited higher titratable acidity than those from the control group. After 21 days of storage, they found that the acidity readings significantly rose ($p<0.05$). It was observed that pH decreased as the amount of melon peel powder in yogurt increased. It can be interpreted that melon peel powder supports microbial growth.

As pH decreased during fermentation, titratable acidity increased. Similarly, Kavak and Akdeniz (2019) stated that pH values in yogurt manufacture that had been supplemented with grape seed extract somewhat decreased. Moreover, during storage, pH values varied between samples with melon peel powder (1, 2, and 3%) and control yogurt. *Streptococcus thermophilus* and *Lactobacillus bulgaricus* are homofermentative bacteria that convert lactose to lactic acid. Lactic acid synthesis leads to a fall in pH, which is to be expected.

It is also feasible to enhance the qualities of yogurt, such as texture, by the formation of aromatic compounds or exopolysaccharides (EPSs) in the industrial sense thanks to the protocooperation interaction between *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (Rul, 2017).

Table 1. The physicochemical analysis of cow milk and melon peel powdered

Analyses	Materials	
	Cow milk	Melon peel powder (MPP)
Total Solids (%)	12.40±0.13	8.85±0.21
Ash (%)	0.61±0.01	6.30±0.04
pH	6.60±0.00	5.19±0.02
Titratable acidity (%)	0.17±0.02	ND
Total Phenolics (mg GAE/g)	ND	2.59±0.09
DPPH	ND	13.15±1.82
*L**	ND	67.44±2.19
*a**	ND	2.61±0.16
*b**	ND	22.28±1.57

*ND Not detected; values are mean ± standard deviation

Table 2. Changes of pH, titratable acidity and count of bacteria in yogurt fortified with melon peel powder during storage at 4°C

Analyses	Applications	Storage Time (day)				Mean
		1	7	14	21	(X ± Sx)
pH	C	4.605	4.575	4.560	4.440	4.545±0.009^{A}
	MPP1	4.545	4.345	4.195	4.140	4.306±0.009^{B}
	MPP2	4.460	4.265	4.180	4.115	4.255±0.009^{C}
	MPP3	4.405	4.220	4.120	4.040	4.196±0.009^{D}
	Mean (X ±Sx)	4.504±0.009^{a}	4.351±0.009^{b}	4.264±0.009^{c}	4.184±0.009^{d}	
Titratable acidity	C	0.965	1.054	1.095	1.039	1.038±0.004^{D}
	MPP1	1.095	1.125	1.147	1.195	1.140±0.004^{C}
	MPP2	1.106	1.188	1.223	1.237	1.188±0.004^{B}
	MPP3	1.140	1.193	1.228	1.257	1.204±0.004^{A}
	Mean (X ±Sx)	1.077±0.004^{c}	1.140±0.004^{b}	1.173±0.004^{a}	1.182±0.004^{a}	
Lactobacillus bulgaric	C	8.800	8.405	8.000	7.830	8.259±0.005^{D}
	MPP1	8.905	8.500	8.300	8.000	8.426±0.005^{C}
	MPP2	8.940	8.600	8.400	8.200	8.535±0.005^{A}
	MPP3	8.920	8.565	8.405	8.180	8.517±0.005^{B}
	Mean (X ±Sx)	8.891±0.005^{a}	8.518±0.005^{b}	8.276±0.005^{c}	8.052±0.005^{d}	
Streptococcus thermophil	C	8.405	8.775	8.000	7.895	8.269±0.10^{C}
	MPP1	8.440	8.800	8.040	8.000	8.320±0.10^{B}
	MPP2	8.250	8.825	8.175	8.100	8.337±0.10^{B}
	MPP3	8.650	8.805	8.150	8.065	8.417±0.10^{A}
	Mean (X ±Sx)	8.436±0.010^{b}	8.801±0.010^{a}	8.091±0.010^{c}	8.015±0.010^{d}	

The horizontal column, lowercase letters (A-D), expresses differences between yogurt samples (p<0.05); the vertical column, capital letters (a-d), expresses differences between storage periods (p<0.05). C: Without melon peel powder; MPP1: 1% melon peel powder; MPP2: 2% melon peel powder; MPP3: 3% melon peel powder

Table 2 presents the findings from lactic acid bacteria and yeast-mold live cells during storage. *Streptococcus thermophilus* and *Lactobacillus bulgaricus* both had viable cell counts that ranged from 7.90 to 8.83 log cfu/mL and 7.83 to 8.94 log cfu/mL, respectively. These starter counts were observed to be lower in the control than in powdered samples. It was shown that during the storage period, there were fewer *L. bulgaricus* yogurts. *S. thermophilus* was found to be more prevalent overall, particularly in MPP3 of the powder-containing samples. Depending on the powder concentration, the number of viable cells of *L. bulgaricus* was assessed at most in 2% concentration and 3% concentration in *S. thermophilus* samples. When *L. bulgaricus* and *S. thermophilus* were tested in terms of storage, the least number of viable cells was found on day 21. Yogurt's enrichment with melon peel powder had a favorable impact on the development of the starting cultures. Perina et al. (2015) reported that after 14 days of preservation in probiotic yogurts with vegetable oil emulsion and powdered passion fruit peel, the average number of live *S. thermophilus* cells was 8.65±0.11 log cfu/g and *L. bulgaricus* as was 6.0 log cfu/g.

None of the yogurt samples during storage had any yeast or mold (<2 log cfu/g). The treatment successfully extends the shelf life of yogurt while also making it safer. The hygienic conditions used during processing and packing determine how long yogurt will last. According to Brahmi et al. (2021), yogurts containing apple peel had coliform, yeast, and mold levels of less than <10 log cfu/mL. These results show that the manufacturing was conducted in hygienic settings.

Dry matter, Ash, Viscosity, Syneresis and Water Holding Capacity (WHC)

Dry matter, ash, viscosity, syneresis and water holding capacity (WHC) are given in Table 3. Dry matter content was between 14.346%±0.015 and 15.381%±0.015. Particularly, it was found that the control sample (C) had less dry matter than the other samples. The ash was found at 0.925±0.03% and 1.204±0.03%. As expected, increasing the melon peel powder content led to an increase in the dry matter and ash values.

Melon peel powder was shown to significantly affect syneresis (p<0.05), with values ranging from 4.912±0.0128 to 8.019±0.0128 (Table 3). The control yielded the highest syneresis value, whereas the MPP3 sample yielded the lowest syneresis. Kabir et al. (2021), found no discernible difference between the yogurt control and banana peel extract samples (p>0.05). Garcia-Perez et al. (2005), the percentage of orange fiber had a significant impact on the yogurts' syneresis values (p<0.05). Adding 0.6% and 0.8% fiber caused the gel structure to break down, which increased the syneresis values. The high WHC of the fiber, which absorbs the water exiting the gel structure when 1% fiber is introduced, was responsible for this impact, though. On the other hand, it was found that during cold storage, syneresis values rose in all yogurt variants (p<0.05). As the storage duration increased, the amount of syneresis decreased.

Unlike syneresis, WHC is a very important physical measurement, as only details of the hardness and stability of coagulants reflect consumer preferences. The yogurt samples' water retaining capacities were measured; the control had the lowest value (50.069±0.229), and the MPP3 had the highest value (58.186±0.229). Moreover, the WHC rose with the rate of MPP addition. It was hypothesized that this would be because the powdered melon peel has a high water absorption capacity and binds more water while in storage. The WHC of yogurt samples was found by Ahmad et al. (2020) to be 53.67% in control, 56.10% in yogurt with 1% apple peel extract, and 66.23% in yogurt with 5% apple peel extract. Yogurts made from camel milk utilizing banana and peel fiber showed WHC, according to Safdari et al. (2021). They mentioned that the high concentration of water-soluble fiber might be to blame for this outcome.

Viscosity is a crucial metric that reveals details about the yogurt's consistency, clot stability, and quality. The control sample had the lowest viscosity value of the samples (2578.00±327.71 cP), while the MPP3 sample had the highest value (2578.00±327.71 cP). The rise in viscosity in samples containing melon peel powder may be the result of the powder absorbing water. Ahmad et al. (2020), the inclusion of apple peel increased the samples' hardness and viscosity while reducing their syneresis. Demirkol and Tarakçı (2018) research, grape pomace powder-enriched yogurts had lower viscosity values than control yogurts. According to Tseng and Zhao (2013), dietary fiber supplied from wine grapes enhanced the viscosity parameters of yogurts. Researchers hypothesized that this rise may be caused by increased milk coagulation during yogurt manufacturing. Nevertheless, Manzoor et al. (2019) produced yogurt with concentrations of 1.5% and 3.0% w/w after drying papaya peel powder at two different temperature ranges, 55 ºC (PP1) and 65 ºC (PP2). According to their findings, samples made with 3% powder (3.0% PP1 and 3.0% PP2) had higher viscosities than samples made with 1.5% powder (1.5% PP1 and 1.5% PP2). Consistency was found between the researchers' findings and the data from this study. When the samples were analyzed in terms of storage, dry matter and ash increased while syneresis and WHC decreased as the storage period increased.

Total Phenolics Content (TPC)

The TPC values of yogurt powdered ranged from 2.50±0.00 to 4.80±0.01 g GAE/100 g (Fig. 1). All of the powdered yogurts showed statistically significant differences ($p<0.05$). By day 21, MPP3 (4.80±0.01 g GAE/100 g) had the highest phenolic content, followed by MPP2 (4.52±0.00 g GAE/100 g), MPP1 (3.96±0.01 g GAE/100 g), control (3.00±0.01 g GAE/100 g). The results showed that the total phenolic content of yogurts increases depending on the amount of melon peel powder concentration.

These outcomes unequivocally demonstrated that the enhanced yogurt polyphenols from melon peel powder might be used as bioactive ingredients in food preparation. According to Ahmad et al. (2020), the control yogurt had a total phenolic content of 1.48 g GAE/100 g DW on the first day of storage. The researchers claimed that the TPC of yogurt samples (3.54, 4.76, 6.11, 7.45, and 8.94 g GAE/100g of DW, respectively) rose with the content of apple peel polyphenol extract (1%, 2%, 3%, 4%, and 5%). In addition, according to the researchers, TPC content rose during the first two weeks while falling during the ensuing second and third weeks. They mentioned that the statistical correlation of the total antioxidant activity of apple peel might be the cause of these results. The phenolic content of yogurts containing passion fruit ranged from 0.50 mg/100 g GAE to 8.01 mg/100 g GAE according to Asiimwe et al. (2021). Kabir et al. (2021), the concentration increase caused the TPC of yogurts containing banana peel extract to rise. It was evaluated that yogurt samples were enhanced with green coffee and green tea powder and had their total phenolic content over time (Dönmez et al., 2017). In addition, the current study results concur with those of the researchers mentioned above.

Table 3. Physicochemical characteristics of yogurt fortified with melon peel powder

Analyses	Applications	Storage Time (day)				Mean (X ± Sx)
		1	7	14	21	
Dry matter (%)	C	14.055	14.305	14.455	14.570	14.346±0.015^{D}
	MPP1	14.670	14.915	15.145	15.205	14.984±0.015^{C}
	MPP2	14.950	15.115	15.215	15.355	15.159±0.015^{B}
	MPP3	15.270	15.300	15.425	15.530	15.381±0.015^{A}
	Mean	14.736±0.015^{d}	14.909±0.015^{c}	15.060±0.015^{b}	15.165±0.015^{a}	(X ±Sx)
Ash (%)	C	0.890	0.905	0.930	0.975	0.925±0.003^{D}
	MPP1	0.965	1.000	1.100	1.120	1.046±0.003^{C}
	MPP2	1.085	1.130	1.155	1.200	1.143±0.003^{B}
	MPP3	1.160	1.200	1.240	1.215	1.204±0.003^{A}
	Mean	1.025±0.003^{d}	1.059±0.003^{c}	1.106±0.003^{b}	1.127±0.003^{a}	(X ±Sx)
Viscocity (cP)	C	2199.50	2399.50	2772.50	2940.50	2578.00±327.71^{B}
	MPP1	3017.50	3630.50	3834.00	3865.00	3586.75±327.71^{AB}
	MPP2	1743.50	3710.50	3953.00	2025.50	2858.13±327.71^{B}
	MPP3	3589.00	3937.00	4147.50	4332.00	4001.38±327.71^{A}
	Mean	2637.38±327.71^{a}	3419.38±327.71^{a}	3676.75±327.71^{a}	3290.75±327.71^{a}	(X ±Sx)
Syneresis (%)	C	9.330	8.975	6.975	6.795	8.019±0.128^{A}
	MPP1	8.850	7.325	7.850	6.225	7.562±0.128^{B}
	MPP2	6.855	6.100	5.700	4.750	5851±0.128^{C}
	MPP3	6.050	5.850	4.100	3.650	4.912±0.128^{D}
	Mean	7.771±0.128^{a}	7.063±0.128^{b}	6.156±0.128^{c}	5.355±0.128^{d}	(X ±Sx)
WHC (%)	C	53.805	51.125	48.945	46.400	50.069±0.229^{D}
	MPP1	56.240	55.160	53.090	51.350	53.960±0.229^{C}
	MPP2	59.035	57.005	54.125	51.610	55.444±0.229^{B}
	MPP3	62.210	59.590	57.855	53.090	58.186±0.229^{A}
	Mean	57.823±0.229^{a}	55.720±0.229^{b}	53.504±0.229^{c}	50.613±0.229^{d}	(X ±Sx)

The horizontal column, lowercase letters (A-D), expresses differences between yogurt samples ($p<0.05$); the vertical column, capital letters (a-d), expresses differences between storage periods ($p<0.05$). C: Without melon peel powder; MPP1: 1% melon peel powder; MPP2: 2% melon peel powder; MPP3: 3% melon peel powder

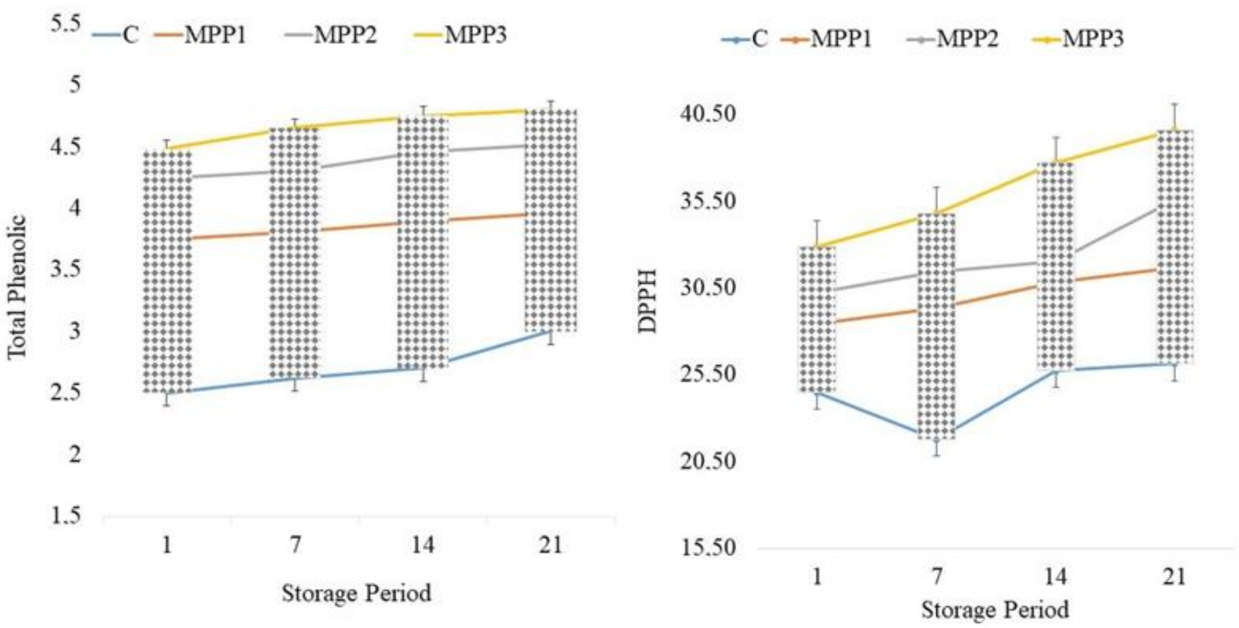

Figure 2. Total phenolic content (g GAE/100g DW) and DPPH (%) contents of yogurt enriched melon peel powder

Antioxidant Activity

In terms of their antiradical capacity (DPPH), yogurts were found to differ significantly ($p<0.05$). While control yogurt had the lowest activity, MPP3 yogurt had the best antioxidant potential. The average antioxidant activity values of yogurt with melon peel powder at 1%, 2% and 3% concentrations were 28.46%, 30.23% and 32.9%, respectively, on the first day of storage, while at the end of storage they were found to be 31.70%, 35.57%, and 39.59% (Fig. 1). Yogurt's higher MPP content had a beneficial impact on its antioxidant capacity. It might highlight yogurts containing melon peel powder, which has significant antioxidant activity due to its high phenolic content and could be employed as a new component in the design of nutraceuticals as well as a natural source of antioxidants. Super red dragon fruit skin was used to make yogurt by Supriyanti and Zackiyah (2020) (F1, F2, and F3 samples were created with 10, 20, and 30% concentrations, respectively). They identified the samples' antioxidant activity as F3, F2, F1, and F0, in order of highest to lowest. Also, they found that the antioxidant activity of the control sample was 15.68% and that it ranged between 63.69% and 92.67% in the samples made with enhanced powder. They found that the antioxidant activity in yogurts with a passion fruit flavor was much higher ($p<0.05$) and increased ($p<0.05$) after storage (Asimwe et al., 2021). Kabir et al. (2021), the condition causes an increase in the radical scavenging ability in both $DPPH^{\bullet}$ and $ABTS^{+\bullet}$ values due to the increase in the concentration of banana peel extract. In comparison to control yogurts (27.13±1.53%), probiotic yogurts containing apple peel polyphenol extract had greater antioxidant activity (Ahmad et al., 2020). This study's results agreed with those of other studies.

Colour Values (L*, a*, b*, ΔE*, H^o^ ve C*)

The L^*, a^*, and b^* values of samples were significantly impacted by enrichment ($p<0.05$), and it was determined that the samples with powder additions had lower L^* values than the control (Table 4). The whiteness of yogurts decreased because of the powder addition, as was to be predicted. In addition, it was shown that the drop in L^* values correlated with an increase in powder ratio. On the 21st day of storage, MPP3 had the lowest L^* value (66.85), whereas on the first day, powder-free C had the greatest L^* value (88.78).

The highest a^* value was observed in MPP3 (4.565) and the lowest in the control group (1.655). At the $p<0.05$ level, it was determined that the addition of melon peel powder and the length of storage had a substantial impact on the a^* value. The first day in MPP3 had the highest b^* value (22.64), whereas the first day in C had the lowest b^* value (12.30). The addition rates of melon peel powder were found to affect b^* values, and significant differences were found between the samples that contained the powder and the control group ($p<0.05$). The color study of melon peel powder yielded a b^* value of 22.28 (Table 1).

Thus, it is assumed that the samples' high b^* values are caused by the melon peel's natural yellowish hue. By increasing the percentage of orange fiber in yogurts, García-Pérez et al. (2005) found a rise in a^* (fewer greens) and b^* values (more yellowness) and a drop in L^* values (less whiteness). L^* values dropped with an increase in the concentration of banana peel extracts (Kabir et al., 2021). Furthermore, as the concentration of banana peel extract in yogurts increased, a* values rose (from 2.64 to 2.72) and b* values fell (from 22.65 to 19.81). During storage, it was detected that the L^*, a^* and b^* values of enriched yogurts became somewhat darker ($\Delta L^*<0$), redder ($\Delta a^*>0$), and less yellow ($\Delta b^*<0$). Adding grape seed extract to yogurt during storage results in a dark brown or reddish color ($\Delta L^*<0$, $\Delta a^*>0$, and $\Delta b^*<0$) (Yadav et al., 2018). On the other hand, yogurt made with orange peel fiber had an L^* value of 89 (Mary et al., 2022). In addition, they evaluated that the L^* values of samples of yogurt containing 0.25% (w/v) of concentrate improved more than controls, while the L^* values of samples of yogurt containing 0.1% (w/v) of partly hydrolyzed guar gum (PHGG) declined. Both the control and fiber-added samples' color change values (ΔE^*) were altered while being stored.

It was found that yogurt sample differences in color difference (ΔE^*), hue value (H^o), and saturation index (C^*) values were statistically significant ($p<0.05$). It was determined that there were variations in the control sample and a general decline in the *C** values of the yogurt samples throughout storage. The *C** value increased along with the melon peel powder content. According to Manzoor et al. (2019), the *C** value of yogurts with papaya peel powder added increased with concentration, while the *C** value of the control was significantly lower than the samples with 1% and 3% powder added. The lowest H^o value (77.44) was found in the MPP3 sample on the first day, and the greatest H^o value (83.68) was found in the control sample on the 21st day. In their investigation of the impacts of pineapple peel powder on yogurt, Shah et al. (2016) found that the H^o value of the yogurts was lower than that of the control. The color results in this study were evaluated following the literature.

Sensory Evaluation

All the sensory qualities considered were impacted by the addition of melon peel powder to yogurt at various rates ($p<0.01$). Storage times had a statistically significant impact on sample appearance scores ($p<0.05$). The MPP3 sample received the lowest scores from the panelists for look and color, 7.45 and 6.83, respectively (Table 2). The analysis of variance revealed that the impact of powder addition on yogurt scores for appearance and color was significant at the $p<0.05$ level. Chouchouli et al. (2013) found that the enrichment of yogurt with grape seed powder created a darker color than the control sample.

The MPP3 sample received the lowest flavor rating (7.40), while the C sample received the highest rating (7.88). The fact that the panelists tasted melon, even in a modest amount, positively affected their flavor ratings. The panelists preferred yogurts with 1% and 2% melon peel powder in particular. Moreover, the rise in acidity with time in storage may be to blame for the decline in flavor ratings. According to Tseng and Zhao (2013), yogurts with 1% wine grape pomace powder received higher ratings for taste and consistency.

Each member of the panel gave samples that contained 1% melon peel powder with greater texture scores. The increase in texture scores can be explained by the lower levels of syneresis in these samples. The yogurt with 2% melon peel powder (MPP2) received the best overall acceptance score (6.86), while the yogurt with no powder received the lowest overall acceptability score (6.50). A broad meaning of the phrase “general acceptability” encompasses sensory judgments like flavor, scent, consistency, and texture. In this regard, yogurt containing 2% powder in the sensory acceptance test (Table 2) had higher acceptance scores than other samples, followed by MPP1, MPP3, and C, respectively.

Table 4. Changes in color parameters in yogurt fortified with melon peel powder during storage

Parameters	Applications	Storage Time (day)				Mean (X ± Sx)
		1	7	14	21	
*L**	C	88.785	88.645	88.295	87.905	88.408±0.003^A
	MPP1	70.275	70.140	70.040	69.895	70.088±0.003^B
	MPP2	68.715	68.545	67.805	67.495	68.140±0.003^C
	MPP3	67.405	67.540	67.300	66.850	67.274±0.003^D
	Mean	73.795±0.003^a	73.718±0.003^b	73.360±0.003^c	73.036±0.003^d	(X ±Sx)
*a**	C	1.925	1.775	1.535	1.385	1.655±0.005^D
	MPP1	2.735	3.030	2.555	2.495	2.704±0.005^C
	MPP2	3.945	3.825	3.605	3.285	3.665±0.005^B
	MPP3	5.045	4.645	4.405	4.165	4.565±0.005^A
	Mean	3.413±0.005^a	3.319±0.005^b	3.025±0.005^c	2.833±0.005^d	(X ±Sx)
*b**	C	12.405	12.745	12.305	12.500	12.489±0.004^D
	MPP1	18.545	18.385	18.260	18.015	18.301±0.004^C
	MPP2	20.645	20.475	19.740	19.500	20.090±0.004^B
	MPP3	22.640	22.505	22.445	22.130	22.430±0.004^A
	Mean	18.559±0.004^a	18.528±0.004^b	18.188±0.004^c	18.036±0.004^d	(X ±Sx)
*C**	C	12.545	12.885	12.400	12.565	12.599±0.002^D
	MPP1	18.735	18.615	18.445	18.205	18.500±0.002^C
	MPP2	21.015	20.825	20.055	19.765	20.415±0.002^B
	MPP3	23.200	22.985	22.855	22.535	22.894±0.002^A
	Mean	18.874±0.002^a	18.828±0.002^b	18.439±0.002^c	18.267±0.002^d	(X ±Sx)
H^0	C	81.103	82.071	82.889	83.677	82.435±0.02^A
	MPP1	81.610	80.641	82.034	82.115	81.600±0.02^B
	MPP2	79.182	79.418	79.650	80.437	79.672±0.02^C
	MPP3	77.438	78.338	78.896	79.341	78.503±0.02^D
	Mean	79.833±0.020^d	80.117±0.020^c	80.867±0.020^b	81.392±0.20^a	(X ±Sx)
Δ*E**	C	89.685	89.585	89.155	88.805	89.308±0.003^A
	MPP1	72.735	72.555	72.410	72.210	72.478±0.003^B
	MPP2	71.865	71.645	70.705	70.315	71.133±0.003^C
	MPP3	71.285	71.325	71.075	70.545	71.058±0.003^D
	Mean	76.393±0.003^a	76.278±0.003^b	75.836±0.003^c	75.469±0.003^d	(X ±Sx)

The horizontal column, lowercase letters (A-D), expresses differences between yogurt samples ($p<0.05$); the vertical column, capital letters (a-d), expresses differences between storage periods ($p<0.05$). C: Without melon peel powder; MPP1: 1% melon peel powder; MPP2: 2% melon peel powder; MPP3: 3% melon peel powder

Table 5. Sensory properties of yogurt fortified with melon peel powder during storage

Parameters	Applications	Storage Time (day)				Mean (X ± Sx)
		1	7	14	21	
Appearance	C	8.455	8.305	8.060	8.250	8.268±0.003[A]
	MPP1	8.000	7.810	7.660	8.000	7.868±0.003[B]
	MPP2	7.950	8.050	7.800	7.370	7.793±0.003[C]
	MPP3	8.000	7.860	7.400	6.540	7.450±0.003[D]
	Mean	8.101±0.003[a]	8.006±0.003[b]	7.730±0.003[c]	7.540±0.003[d]	(X ±Sx)
Colour	C	6.300	7.325	7.690	8.000	7.329±0.005[A]
	MPP1	6.165	7.100	7.550	7.830	7.161±0.005[B]
	MPP2	6.065	7.000	7.405	7.555	7.006±0.005[C]
	MPP3	6.000	6.840	7.200	7.310	6.837±0.005[D]
	Mean	6.132±0.005[d]	7.066±0.005[c]	7.461±0.005[b]	7.674±0.005[a]	(X ±Sx)
Flavour	C	7.500	7.900	8.000	8.100	7.875±0.009[A]
	MPP1	7.150	7.725	7.825	8.005	7.676±0.009[B]
	MPP2	7.000	7.590	7.675	7.900	7.541±0.009[C]
	MPP3	6.910	7.410	7.500	7.780	7.400±0.009[D]
	Mean	7.140±0.009[d]	7.656±0.009[c]	7.750±0.009[b]	7.946±0.009[a]	(X ±Sx)
Texture	C	6.800	7.900	8.000	8.150	7.713±0.01[A]
	MPP1	6.500	7.690	7.940	8.030	7.540±0.01[B]
	MPP2	6.300	7.400	7.590	7.810	7.275±0.01[C]
	MPP3	5.850	7.205	7.300	7.430	6.946±0.01[D]
	Mean	6.362±0.010[d]	7.549±0.010[c]	7.707±0.010[b]	7.855±0.010[a]	(X ±Sx)
Acceptability	C	6.805	6.635	6.440	6.100	6.495±0.005[D]
	MPP1	6865	6.805	6.740	6.300	6.678±0.005[B]
	MPP2	7.000	6.950	7.000	6.475	6.856±0.005[A]
	MPP3	6.905	6.705	6.600	6.065	6.569±0.005[C]
	Mean (X ±Sx)	6.894±0.005[a]	6.774±0.005[b]	6.695±0.005[c]	6.235±0.005[d]	

The horizontal column, lowercase letters (A-D), expresses differences between yogurt samples ($p<0.05$); the vertical column, capital letters (a-d), expresses differences between storage periods ($p<0.05$). C: Without melon peel powder; MPP1: 1% melon peel powder; MPP2: 2% melon peel powder; MPP3: 3% melon peel powder

Yogurts supplemented with grape seed powder were better liked than the control, and those made with apple peel powder were less well-liked, according to the Brahmi et al. (2021) report. This outcome might be due to the smoother texture of the yogurts made with grape seed powder compared to the control yogurts, which also contained apple peel powder. The sensory criteria (taste, color, texture, consistency, flavor, and general acceptability) of yogurts with dried passion fruit powder have not been shown to change statistically significantly ($p>0.05$) during storage (Asiimwe et al., 2021).

Conclusion

The effects on the quality and storage durability of yogurt samples were examined in this study using various amounts of yogurt made with melon peel powder. It was shown that the dry matter and ash values statistically increased with the addition of powder in tandem with the increase in concentration ($p<0.05$). MPP-enriched yogurt substantially differed from all other samples' a^* and b^* values during storage ($p<0.05$). When melon peel powder (1, 2, or 3%) was added to yogurt, the pH, titratable acidity, and viable cell counts changed. Moreover, during storage, syneresis values declined while WHC and TPC values rose. With an increase in powder concentration, antioxidant activity and total phenolic contents rose. Yet, compared to the control yogurt sample, all of the powder-enriched yogurts had increased antioxidant activity.

Among the samples, the yogurt with 2% melon peel powder added had the greatest taste profile and highest sensory ratings. The study's findings suggested that adding melon peel powder to product preparation could enhance yogurt's beneficial qualities and help minimize food waste to safeguard the environment.

Declarations

Conflict of Interest The authors declare that they have no competing conficts of interest.

References

Ahmad, I., Khalique, A., Shahid, M. Q., Rashid, A. A, Faiz, F., Ikram, M. A., Ahmed S., Imran, M., Khan, M.A., Nadeem, M., Afzal, M.I., Umer, M., Kaleem, I., Shahbaz, M., & Rasool, B. (2020). Studying the influence of apple peel polyphenol extract fortification on the characteristics of probiotic yoghurt. *Plants, 9*(1), 77. https://doi.org/10.3390/plants9010077

Al-Sayed, H. M., & Ahmed, A. R. (2013). Utilization of watermelon rinds and sharlyn melon peels as a natural source of dietary fiber and antioxidants in cake. *Annals of Agricultural Sciences, 58*(1), 83-95. https://doi.org/10.1016/j.aoas.2013.01.012

Asiimwe, A., Kigozi, J. B., & Muyonga, J. (2021). Physicochemical Properties, Sensory Acceptance and Storage Stability of Yogurt Flavored with Refractance Window Dried Passion Fruit Powder. *Asian Food Science Journal, 20*(5), 38-49. https://doi.org/10.9734/AFSJ/2021/v20i530297

AOAC, (1999). Official methods of analysis of the Association of Official Analytical Chemists (16th ed.). Washington: AOAC.

Brahmi, F., Merchiche, F., Mokhtari, S., Smail, L., Guemghar-Haddadi, H., Yalaoui-Guellal, D., Achat, S., Fahmi Elsebai, M., Madani, K., & Boulekbache, L. (2021). Optimization of some extraction parameters of phenolic content from apple peels and grape seeds and enrichment of yogurt by their powders: A comparative study. *Journal of Food Processing and Preservation, 45*(2), e15126. https://doi.org/10.1111/jfpp.15126

Bierzuńska, P., Cais-Sokolińska, D., & Yiğit, A. (2019). Storage stability of texture and sensory properties of yogurt with the addition of polymerized whey proteins. *Foods, 8*(11), 548. https://doi.org/10.3390/foods8110548

Bodyfelt, F. W., Tobias, J., & Trout, G. M. (1988). The sensory evaluation of dairy products (Vol. 598). New York: Van Nostrand Reinhold.

Campos, D. A., Gómez-García, R., Vilas-Boas, A. A., Madureira, A. R., & Pintado, M. M. (2020). Management of fruit industrial by-products-a case study on circular economy approach. *Molecules, 25*(2), 320. https://doi.org/10.3390/molecules25020320

Chantaro, P., Devahastin, S., & Chiewchan, N. (2008). Production of antioxidant high dietary fiber powder from carrot peels. *LWT-Food Science and Technology, 41*(10), 1987-1994. https://doi.org/10.1016/j.lwt.2007.11.013

Chouchouli, V., Kalogeropoulos, N., Konteles, S. J., Karvela, E., Makris, D. P., & Karathanos, V. T. (2013). Fortification of yoghurts with grape (*Vitis vinifera*) seed extracts. *LWT-Food Science and Technology, 53*(2), 522-529. https://doi.org/10.1016/j.lwt.2013.03.008

Comunian, T. A., Silva, M. P., & Souza, C. J. (2021). The use of food by-products as a novel for functional foods: Their use as ingredients and for the encapsulation process. *Trends in Food Science & Technology, 108*, 269-280. https://doi.org/10.1016/j.tifs.2021.01.003

Cueva, O., & Aryana, K. J. (2008). Quality attributes of a heart healthy yogurt. *LWT-Food Science and Technology, 41*(3), 537-544. https://doi.org/10.1016/j.lwt.2007.04.002

da Silva, A. C., & Jorge, N. (2014). Bioactive compounds of the lipid fractions of agro-industrial waste. *Food Research International, 66*, 493-500. https://doi.org/10.1016/j.foodres.2014.10.025

Delikanlı, B., & Özcan, T. (2014). Effects of various whey proteins on the physicochemical and textural properties of set type nonfat yoghurt. *International Journal of Dairy Technology, 67*(4), 495-503. https://doi.org/10.1111/1471-0307.12142

Demirkol, M., & Tarakçı, Z. (2018). Effect of grape (*Vitis labrusca* L.) pomace dried by different methods on physicochemical, microbiological and bioactive properties of yoghurt. *Lwt, 97*, 770-777. https://doi.org/10.1016/j.lwt.2018.07.058

Dinkçi, N., Aktaş, M., Akdeniz, V., & Sirbu, A. (2021). The Influence of hazelnut skin addition on quality properties and antioxidant activity of functional yogurt. *Foods, 10*(11), 2855. https://doi.org/10.3390/foods10112855

Dönmez, Ö., Mogol, B. A., & Gökmen, V. (2017). Syneresis and rheological behaviors of set yogurt containing green tea and green coffee powders. *Journal of Dairy Science, 100*(2), 901-907. https://doi.org/10.3168/jds.2016-11262

Fundo, J. F., Miller, F. A., Garcia, E., Santos, J. R., Silva, C. L., & Brandão, T. R. (2018). Physicochemical characteristics, bioactive compounds and antioxidant activity in juice, pulp, peel and seeds of Cantaloupe melon. *Journal of Food Measurement and Characterization, 12*, 292-300. https://doi.org/10.1007/s11694-017-9640-0

García-Pérez, F. J., Lario, Y., Fernández-López, J., Sayas, E., Pérez-Alvarez, J. A., & Sendra, E. (2005). Effect of orange fiber addition on yogurt color during fermentation and cold storage. Color Research & Application: Endorsed by Inter-Society Color Council, The Colour Group (Great Britain), Canadian Society for Color, Color Science Association of Japan, Dutch Society for the Study of Color, The Swedish Colour Centre Foundation, Colour Society of Australia, *Centre Français de la Couleur, 30*(6), 457-463.

Gassem, M. A., & Frank, J. F. (1991). Physical properties of yogurt made from milk treated with proteolytic enzymes. *Journal of Dairy Science, 74*(5), 1503-1511. https://doi.org/10.3168/jds.S0022-0302(91)78310-0

Gómez-García, R., Campos, D. A., Aguilar, C. N., Madureira, A. R., & Pintado, M. (2020). Valorization of melon fruit (*Cucumis melo* L.) by-products: Phytochemical and Biofunctional properties with Emphasis on Recent Trends and Advances. *Trends in Food Science & Technology, 99*, 507-519. https://doi.org/10.1016/j.tifs.2020.03.033

Gómez-García, R., Campos, D. A., Aguilar, C. N., Madureira, A. R., & Pintado, M. (2021). Valorisation of food agro-industrial by-products: From the past to the present and perspectives. *Journal of Environmental Management, 299*, 113571. https://doi.org/10.1016/j.jenvman.2021.113571

Harrigan, W. (1998). Laboratory methods in food microbiology: Gulf Professional Publishing.

İsmail, H. I., Chan, K. W., Mariod, A. A., & İsmail, M. (2010). Phenolic content and antioxidant activity of cantaloupe (*Cucumis melo*) methanolic extracts. *Food Chemistry, 119*(2), 643-647. https://doi.org/10.1016/j.foodchem.2009.07.023

Kabir, M. R., Hasan, M. M., Islam, M. R., Haque, A. R., & Hasan, S. K. (2021). Formulation of yogurt with banana peel extracts to enhance storability and bioactive properties. *Journal of Food Processing and Preservation, 45*(3), e15191. https://doi.org/10.1111/jfpp.15191

Kavak, D. D., & Akdeniz, B. (2019). Physicochemical characteristics and antioxidant capacity of traditional yogurt fortified with grape (*Vitis vinifera* L.) seed extract at different levels. *Kocatepe Veterinary Journal, 12*(4), 398-395. https://doi.org/10.30607/kvj.596784

Kurt, A., Çakmakçı, S., & Çağlar, A. (2007). A guide book of analysis methods of milk and milk products. Turkey: Ataturk University, Agriculture Faculty, Erzurum, Turkey.

Kurtuldu, O., & Özcan, T. (2018). Effect of β-glucan on the properties of probiotic set yoghurt with *Bifidobacterium animalis* subsp. *lactis* strain Bb-12. *International Journal of Dairy Technology, 71*, 157-166. https://doi.org/10.1111/1471-0307.12414

Lee, S. C., Kim, J. H., Jeong, S. M., Kim, D. R., Ha, J. U., Nam, K. C., & Ahn, D. U. (2003). Effect of far-infrared radiation on the antioxidant activity of rice hulls. *Journal of Agricultural and Food Chemistry, 51*(15), 4400-4403. https://doi.org/10.1021/jf0300285

Li, Z., Yao, L., Yang, Y., & Li, A. (2006). Transgenic approach to improve quality traits of melon fruit. *Scientia Horticulturae, 108*(3), 268-277. https://doi.org/10.1016/j.scienta.2006.02.005

Lucas-Torres, C., Lorente, A., Cabanas, B., & Moreno, A. (2016). Microwave heating for the catalytic conversion of melon rind waste into biofuel precursors. *Journal of Cleaner Production, 138*, 59-69. https://doi.org/10.1016/j.jclepro.2016.03.122

Mallek-Ayadi, S., Bahloul, N., & Kechaou, N. (2017). Characterization, phenolic compounds and functional properties of Cucumis melo L. peels. *Food Chemistry, 221*, 1691-1697. https://doi.org/10.1016/j.foodchem.2016.10.117

Manzoor, S., Yusof, Y. A., Chin, N. L., Tawakkal, A., Mohamed, I. S., Fikry, M., & Chang, L. S. (2019). Quality Characteristics and Sensory Profile of Stirred Yogurt Enriched with Papaya Peel Powder. *Pertanika Journal of Tropical Agricultural Science, 42*(2).

Mary, P. R., Mutturi, S., & Kapoor, M. (2022). Non-enzymatically hydrolyzed guar gum and orange peel fibre together stabilize the low-fat, set-type yogurt: A techno-functional study. *Food Hydrocolloids, 122*, 107100. https://doi.org/10.1016/j.foodhyd.2021.107100

Nalbant, D., & Yüceer, Y. (2020). İnek ve keçi sütü kullanılarak üretilen probiyotik fermente süt ürünlerinin karakteristik özellikleri. *Gıda, 45*(2), 315-328. https://doi.org/10.15237/gida.GD19126

Pérez-Chabela, M. D. L., Cebollòn-Juàrez, A., Bosquez-Molina, E., & Totosaus, A. (2021). Mango peel flour and potato peel flour as bioactive ingredients in the formulation of functional yogurt. *Food Science and Technology, 42*. https://doi.org/10.1590/fst.38220

Perina, N. P., Granato, D., Hirota, C., Cruz, A. G., Bogsan, C. S. B., & Oliveira, M. N. D. (2015). Effect of vegetal-oil emulsion and passion fruit peel-powder on sensory acceptance of functional yogurt. *Food Research International, 70*, 134-141. https://doi.org/10.1016/j.foodres.2015.01.014

Raji, Z., Khodaiyan, F., Rezaei, K., Kiani, H., & Hosseini, S. S. (2017). Extraction optimization and physicochemical properties of pectin from melon peel. *International Journal of Biological Macromolecules, 98*, 709-716. https://doi.org/10.1016/j.ijbiomac.2017.01.146

Rațu, R. N., Veleșcu, I. D., Stoica, F., Usturoi, A., Arsenoaia, V. N., Crivei, I. C., Postolache, A. N., Lips, F. D., Filipov, F., Florea, A.M., Chițea, M. A., & Brumă, I. S. (2023). Application of Agri-Food By-Products in the Food Industry. *Agriculture, 13*(8), 1559. https://doi.org/10.3390/agriculture13081559

Remeuf, F., Mohammed, S., Sodini, I., & Tissier, J. P. (2003). Preliminary observations on the effects of milk fortification and heating on microstructure and physical properties of stirred yogurt. *International Dairy Journal, 13*(9), 773-782. https://doi.org/10.1016/S0958-6946(03)00092-X

Rodríguez-Pérez, C., Quirantes-Piné, R., Fernández-Gutiérrez, A., & Segura-Carretero, A. (2013). Comparative characterization of phenolic and other polar compounds in Spanish melon cultivars by using high-performance liquid chromatography coupled to electrospray ionization quadrupole-time of flight mass spectrometry. *Food Research International, 54*(2), 1519-1527. https://doi.org/10.1016/j.foodres.2013.09.011

Rolim, P. M., Fidelis, G. P., Padilha, C. E. A., Santos, E. S., Rocha, H. A. O., & Macedo, G. R. (2018). Phenolic profile and antioxidant activity from peels and seeds of melon (*Cucumis melo* L. var. *reticulatus*) and their antiproliferative effect in cancer cells. *Brazilian Journal of Medical and Biological Research, 51*. https://doi.org/10.1590/1414-431X20176069

Rolim, P. M., Seabra, L. M. A. J., & de Macedo, G. R. (2020). Melon by-products: Biopotential in human health and food processing. *Food Reviews International, 36*(1), 15-38. https://doi.org/10.1080/87559129.2019.1613662

Rul, F. (2017). Yogurt microbiology, organoleptic properties and probiotic potential. In Fermented Foods (pp. 418-450). CRC Press.

Safdari, Y., Vazifedoost, M., Didar, Z., & Hajirostamloo, B. (2021). The effect of banana fiber and banana peel fibre on the chemical and rheological properties of symbiotic yogurt made from camel milk. *International Journal of Food Science, 2021*. https://doi.org/10.1155/2021/5230882

Shofian, N. M., Hamid, A. A., Osman, A., Saari, N., Anwar, F., Pak Dek, M. S., & Hairuddin, M. R. (2011). Effect of freeze-drying on the antioxidant compounds and antioxidant activity of selected tropical fruits. *International Journal of Molecular Sciences, 12*(7), 4678-4692. https://doi.org/10.3390/ijms12074678

Singleton, V. L., & Rossi, J. A. (1965). Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. *American Journal of Enology and Viticulture, 16*(3), 144-158. https://doi.org/10.5344/ajev.1965.16.3.144

Supriyanti, F., Zackiyah, Z., & Finandia, F. (2020, July). Determination of Antioxidant Activity and Physico-Chemicals Characteristics of Fortified Yogurt Powder by Super Red Dragon (*Hylocereus polyrhizus*) Fruit Peel Powder. In Proceedings of the 7th Mathematics, Science, and Computer Science Education International Seminar, MSCEIS 2019, 12 October 2019, Bandung, West Java, Indonesia. http://dx.doi.org/10.4108/eai.12-10-2019.2296463

The World Counts, (2024). https://www.theworldcounts.com/challenges/people-and-poverty/hunger-and-obesity/food-waste-statistics (Accessed on 16 February 2024).

Trigo, J. P., Alexandre, E. M., Saraiva, J. A., & Pintado, M. E. (2022). High value-added compounds from fruit and vegetable by-products–Characterization, bioactivities, and application in the development of novel food products. *Critical Reviews in Food Science and Nutrition, 60*(8), 1388-1416. https://doi.org/10.1080/10408398.2019.1572588

Tseng, A., & Zhao, Y. (2013). Wine grape pomace as antioxidant dietary fibre for enhancing nutritional value and improving storability of yogurt and salad dressing. *Food Chemistry, 138*(1), 356-365. https://doi.org/10.1016/j.foodchem.2012.09.148

Vinderola, C. G., & Reinheimer, J. A. (1999). Culture media for the enumeration of *Bifidobacterium bifidum* and *Lactobacillus acidophilus* in the presence of yoghurt bacteria. *International Dairy Journal, 9*(8), 497-505. https://doi.org/10.1016/S0958-6946(99)00120-X

Yadav, K., Bajaj, R. K., Mandal, S., Saha, P., & Mann, B. (2018). Evaluation of total phenol content and antioxidant properties of encapsulated grape seed extract in yoghurt. *International Journal of Dairy Technology, 71*(1), 96-104. https://doi.org/10.1111/1471-0307.12464

Ye, M., Ren, L., Wu, Y., Wang, Y., & Liu, Y. (2013). Quality characteristics and antioxidant activity of hickory-black soybean yogurt. *LWT-Food Science and Technology, 51*(1), 314-318. https://doi.org/10.1016/j.lwt.2012.09.027

Wang, X., Kristo, E., & LaPointe, G. (2019). The effect of apple pomace on the texture, rheology and microstructure of set type yogurt. *Food Hydrocolloids, 91*, 83-91. https://doi.org/10.1016/j.foodhyd.2019.01.004