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Determination of quality characteristics of some Monofloral, Polyfloral and Honeydew honeys in terms of physical properties and Proline content

Fiziksel özellikler ve Prolin içeriği bakımından bazı Monofloral, Polifloral ve Salgı ballarının kalite özelliklerinin tespiti

Merve Özbay[1,*], Fatma Nur Arslan[2], Gazi Görür[3]

[1] *Karamanoglu Mehmetbey University, Department of Gastronomy and Culinary Arts, 70100, Karaman, Türkiye*
[2] *Karamanoglu Mehmetbey University, Department of Chemistry, 70100, Karaman, Türkiye*
[3] *Niğde Ömer Halisdemir University, Department of Biotechnology, 51240, Niğde, Türkiye*

Abstract

This study aims to investigate some physical properties and proline content of 95 different honey samples to reveal their characteristic features and evaluate their quality according to the Turkish Food Codex. The moisture content, which is highly important parameter in determining the shelf life of honeys, determined between 14.60% and 21.20% and these values were determined to be within the limits (<20%) except for four honey samples. The brix values of honey samples were examined between 77.23% and 83.60%, and they were found to be within the acceptable range. The other physical parameter, namely the electrical conductivity values of samples determined between 0.11 and 1.20 mS/cm. Proline, which is an important value in determining the type and maturity of honey and is the amino acid found in the highest amount in honey, should be above 300 mg/kg in honey, according to the communique. The proline amount of the honey samples examined varied between 281.61 and 2259.43 mg/kg. It was determined that the proline amount of two honey samples were below the limit. It was concluded that most of the tested samples were in compliance with the food codex in terms of quality standards.

Anahtar kelimeler: Honey, Proline, Brix, Electrical conductivity, Moisture

Öz

Çalışma, balların karakteristik özelliklerini ortaya koymak ve Türk Gıda Kodeksi Tebliğine göre kalitelerini değerlendirmek için 95 farklı bal numunesinin bazı fiziksel özelliklerini ve prolin miktarını araştırmayı amaçlamaktadır. Balların raf ömürlerinin belirlenmesinde oldukça önemli bir parametre olan nem içeriği, incelenen bal numunelerinde %14.60-%21.20 arasında değişim göstermiştir ve dört bal numunesi hariç limitler (<%20) dahilinde olduğu belirlenmiştir. İncelenen bal numunelerinin briks değerleri %77.23-%83.60 arasında değişim göstermiştir ve kabul edilebilir aralıkta olduğu görülmüştür. Bal numunelerinin elektriksel iletkenlik değerleri 0.11-1.20 mS/cm arasında değişim göstermiştir. Balın tipinin ve olgunluğunun belirlenmesinde yararlı ve önemli bir değer olan ve balda en yüksek oranda bulunan aminoasit olan prolin, ballarda tebliğe göre 300 mg/kg'ın üzerinde olmalıdır. İncelenen bal numunelerinin prolin miktarı 281.61-2259.43 mg/kg aralığında değişim göstermiştir. İki bal numunesinin prolin miktarlarının limitin altında olduğu belirlenmiştir. Sonuç olarak, test edilen bal numunelerinin çoğunun kalite açısından gıda kodeksi ile uyumlu olduğu kanaatine varılmıştır.

Keywords: Bal, Prolin, Brix, Elektriksel iletkenlik, Nem

1 Introduction

Honey is one of the most complicated nutrition produced by honeybees from the plants or nectar of diverse honeydews [1, 2]. It has an important situate in human nutrition. Although most of its ingredient is sugar, it does not only occur of sugar, but also it includes nutritive and medicinal effects [3]. Due to its amino acid, organic acid, mineral, vitamin, enzyme and flavonoid contents, is a significant food that is nutritive, easily digestible and has preventive properties opposite diverse diseases [4-7]. The chemical compound of honey varies according to its geographic and botanic root. But, the honey basically occurs of macro and micro ingredients such as 17% water, 82% carbohydrates, 0.3% protein, 0.7% minerals, organic acids, vitamins, free amino acids and phenols compounds [8-10]. Proline, elements, moisture, 5-hydroxymethylfurfural (HMF), organic acids, enzymes, vitamins, sugar, pH, glucose and fructose ratios, electrical conductivity, acidity, etc. parameters define the valuation of honeys [11]. As honey is an essential daily-life dietary addition, it is significant to appraise its quality to provide its purity and to be sure that it has all components available in it. This quality control assessment could be done by determining the physicochemical parameters and to evaluate the purity of honeys [12-14]. The moisture is an important parameter in determining the shelf life of honey. The high moisture value causes premature deterioration and crystallization of honey [15, 16]. This parameter means in defining water content of honey ingredients which influences honey stability opposite fermentation. Besides, moisture analysis could help the

* Sorumlu yazar/ Corresponding author, e-posta / e-mail: mozbay@kmu.edu.tr (M. Özbay)
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honey manufacturer to protect the carrying terms and suitable storage [17]. Since electrical conductivity is an important criterion in determining the botanical origin of honey, it is frequently used for routine controls of honey [18] and is an important criterion in distinguishing secretion honey from flower honey [19]. The degree of unadulterated honey varies between 78.8-84.0%. The brix degree of honey is related not only to its sugar content but also to its moisture [20]. The proline constitutes 50-85% of the amino acids found in honey [21]. The honey has been reported to contain higher levels of proline and potassium than adulterated honey [22].

Herein, to reveal the characteristic features of honey and evaluate their quality according to the Turkish Food Codex Honey Communiqué [23], some physical properties (moisture content, brix percentage, electrical conductivity) and proline amount of 95 different flower and honeydew honey samples were investigated.

2 Material and methods

2.1 Chemicals and instruments.

Proline (European Pharmacopoeia EP), ultrapure water, 2–propanol, formic acid and ninhydrin were purchased from commercial suppliers and used directly without any purification. An Agilent Cary 60 UV–Vis spectrophotometer was used to record spectra of proline analyses. Kyoto KEM RA–600 refractometer was used to record moisture and brix data. For the electrical conductivity analysis, Mettler Toledo SevenCompact conductivity device was used.

2.2 Samples

95 honey samples including 12 kinds of monofloral honey (MH) samples [n=55 honeys; thyme (MH_TV1 to TV6), acacia (MH_A1 to A2), carob (MH_C1 to C5), chestnut (MH_CH1 to CH6), black cumin (MH_BC1 to BC4), milk vetch (MH_MV1 to MV7), sunflower (MH_S1 to S3), citrus (MH_CF1 to CF8), rhododendron (MH_R1 to R3), thistle (MH_T1), linden (MH_L1 to L5), lavender (MH_FL1 to FL5)], 20 polyfloral honey (PH) samples obtained from 2019–2020 seasons (n=20; PH_1 to 20) and 2 kinds of honeydew honeys (HH) [n=20 honeys; honeydew (HH_H1 to H14) and oak (HH_O1 to O6)] were used. All samples were purchased from the local markets, factory outlets and local beekeepers, and they were stored at +4°C in a cabinet away from daylight.

2.3 Moisture analysis

The amount of moisture in honey samples was determined by using the refractive index value obtained at 20 ºC with a calibrated refractometer and the moisture calculation chart [24]. For this purpose, a moisture amount of each sample was taken and placed on the prism of the refractometer, the lid was closed so that no air bubbles remained and three repeated readings were made.

2.4 Brix analysis

Brix values at 20 ºC were measured at least three times using a calibrated refractometer device and their means were expressed as % brix values [25].

2.5 Electrical conductivity analysis

Electrical conductivity was analyses were carried out according to the Turkish Standard method [26]. After dissolving 10 g of honey sample with 100 mL of ultrapure water, repeated readings were performed with a calibrated conductivity measuring device. By averaging the data, the electrical conductivity of the honey samples at 25 °C was reported as mS/cm.

2.6 Proline analysis

The proline analyses of honeys were carried out by using UV-Vis spectrophotometer, based on the principle that the amino acid proline forms a colored complex with ninhydrin that gives absorbance at 510 nm. 40 mg of dried proline was dissolved with ultrapure water and made up to 50 mL in a volumetric flask. Standard proline solutions were prepared by taking 0.5 mL, 1 mL and 2 mL of the prepared stock proline solution. 0.5 mL of each of these solutions was taken and placed in glass tubes. 1 mL of formic acid and 1 mL of 3% ninhydrin solution were added, and the tubes were shaken carefully and vigorously for 15 minutes. At the end of shaking, it was kept in a boiling water bath for 15 min. Then it was kept in a 70 ºC water bath for 10 min. Immediately at the end of the period, 5 mL of 50% 2-propanol solution was added to the tubes. The tubes were turned upside down and read at 510 nm [27].

5 g of honey was weighed, dissolved in 50 mL of ultrapure water, transferred to the volumetric flask and made up to 100 mL with ultrapure water, and the tube was shaken. 0.5 mL of the honey solution was taken and placed in the test tube. For the blank sample, 0.5 mL of ultrapure water was put into the test tube. 1 mL of formic acid and 1 mL of 3% ninhydrin solution were added and the tubes were shaken carefully for 15 min. At the end of shaking, it was kept in a boiling water bath for 15 min. Then it was kept in a 70 ºC water bath for 10 min. Immediately at the end of the period, 5 mL of 2-propanol solution was added to the tubes. The tubes were inverted and their concentrations (mg/kg) were recorded at 510 nm.

3 Results and discussion

3.1 Moisture

It was determined that the moisture content of the honey samples used in this study varied between 14.60% and 21.20% (Table 1). While the highest moisture content was detected for the MH_L4 honey sample, the lowest moisture content was detected for the MH_MV3 honey sample. It has been determined that some honeys have a moisture content of over 20%.

3.2 Brix

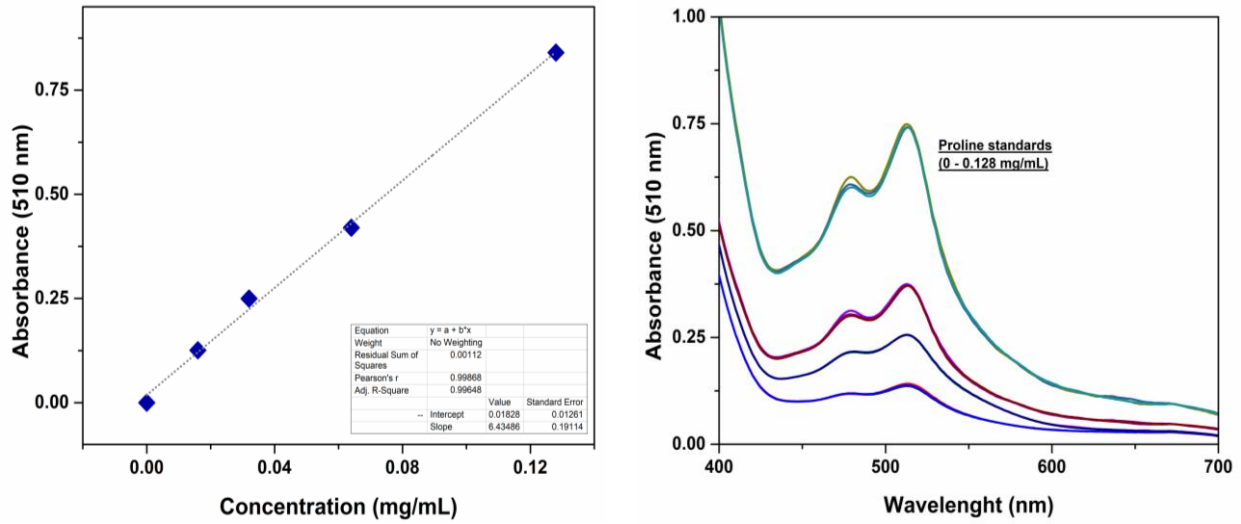
The brix values of honey samples were found between 77.23% and 83.60%. The highest brix value was determined for the MH_MV3, MH_A2 and HH_O2 honey samples (Table 1). The lowest moisture content was determined for the MH_MV3 honey sample, which indicates a high brix value. It was concluded that honey with low % moisture content had high % brix values.

3.3 Electrical conductivity

The electrical conductivity values of honey samples were determined between 0.11 and 1.20 mS/cm (Table 1). The electrical conductivity of honey depends on the mineral content of honey. According to the Turkish Food Codex Honey Communiqué (Communiqué No: 2020/7), the electrical conductivity value in flower honey should not be more than 0.8 mS /cm. The electrical conductivity values of the monofloral and polyfloral honey samples tested in this study were found to be in accordance with the communique. It has been stated that this value should be at least 0.8 mS /cm for honeydew honeys and chestnut honeys, which are monofloral honeys. The results of the electrical conductivity were in accordance with the communique, except for the chestnut honey samples (MH_CH1, MH_CH3 and MH_CH4). Since honeydew honey is a mixture of flower honey, its electrical conductivity values were determined to be less than 0.8 mS /cm.

3.4 Proline

The amounts of proline were given by calculating the standard proline concentrations versus absorbance value in Figure 1, according to the formulation y=5.6929x+0.0323. The values were reported by calculating the proline amounts of honeys (mg/kg) (Table 1). According to the Turkish Food Codex, the proline value of honey should be over 300 mg/kg. The amounts of proline in samples were found between 281.61 and 2259.43 mg/kg. It was observed that the levels were lower in MH_A2 and MH_CF5 samples compared to the other samples. The highest amount of proline was detected for the MH_BC2 sample. The average proline amount of monofloral honey samples was found to be 939.38 mg/kg, the average proline amount of polyfloral honey samples was 870.00 mg/kg, and the average proline amount of honeydew honey samples was 1008.58 mg/kg. Thus, the proline values were high on average and in accordance with the values determined by the food codex.



(a) (b)

Figure 1. (a) Calibration graph and (b) spectra recorded with proline standard material

Table 1. Results for the moisture, brix, electrical conductivity and proline analyses of honeys

	Moisture, %	Brix, %	Electrical conductivity, mS/cm	Proline content, mg/kg
MH Samples				
MH_A1	16.70 ±0.00	81.57 ±0.06	0.24 ±0.01	705.89 ±0.00
MH_A2	14.70 ±0.00	83.57 ±0.06	0.18 ±0.00	281.61 ±0.00
MH_BC1	20.20 ±0.00	78.20 ±0.00	0.67 ±0.00	2031.78 ±0.00
MH_BC2	18.30 ±0.00	80.07 ±0.06	0.48 ±0.09	2259.43 ±0.00
MH_BC3	17.80 ±0.00	80.50 ±0.00	0.47 ±0.12	1923.88 ±0.00
MH_BC4	16.90 ±0.00	81.30 ±0.10	0.44 ±0.07	2246.04 ±0.00
MH_C1	16.50 ±0.00	81.73 ±0.15	0.61 ±0.01	651.11 ±0.00
MH_C2	16.70 ±0.00	81.57 ±0.06	0.23 ±0.00	357.20 ±0.00
MH_C3	16.20 ±0.00	82.03 ±0.15	0.60 ±0.01	1078.52 ±0.00
MH_C4	16.90 ±0.00	81.37 ±0.12	0.41 ±0.01	802.73 ±0.00
MH_C5	16.90 ±0.00	81.40 ±0.17	0.41 ±0.01	942.71 ±0.00
MH_CF1	17.30 ±0.00	81.03 ±0.06	0.17 ±0.05	608.19 ±0.00
MH_CF2	18.30 ±0.00	80.00 ±0.00	0.11 ±0.00	378.48 ±0.00
MH_CF3	15.60 ±0.00	82.60 ±0.10	0.22 ±0.04	687.21 ±0.00

MH_CF4	18.10 ±0.00	80.20 ±0.10	0.39 ±0.01	637.63 ±0.00
MH_CF5	19.30 ±0.00	78.97 ±0.21	0.19 ±0.06	292.19 ±0.00
MH_CF6	20.30 ±0.00	78.07 ±0.06	0.48 ±0.02	794.26 ±0.00
MH_CF7	18.20 ±0.00	80.10 ±0.00	0.17 ±0.05	445.77 ±0.00
MH_CF8	18.70 ±0.00	79.73 ±0.06	0.20 ±0.05	387.97 ±0.00
MH_CH1	16.30 ±0.00	81.93 ±0.06	0.74 ±0.00	907.12 ±0.00
MH_CH2	17.50 ±0.00	80.70 ±0.10	1.07 ±0.00	1341.82 ±0.00
MH_CH3	18.20 ±0.00	80.13 ±0.06	0.77 ±0.01	1457.05 ±0.00
MH_CH4	17.50 ±0.00	80.80 ±0.10	0.63 ±0.00	976.23 ±0.00
MH_CH5	17.80 ±0.00	80.50 ±0.10	1.16 ±0.01	835.97 ±0.00
MH_CH6	17.30 ±0.00	81.03 ±0.15	1.20 ±0.00	1110.35 ±0.00
MH_FL1	15.90 ±0.00	82.37 ±0.06	0.28 ±0.05	1596.38 ±0.00
MH_FL2	16.10 ±0.00	82.10 ±0.10	0.17 ±0.03	943.04 ±0.01
MH_FL3	17.10 ±0.00	81.10 ±0.10	0.21 ±0.00	1671.96 ±0.00
MH_FL4	17.70 ±0.00	80.53 ±0.15	0.23 ±0.03	1470.23 ±0.00
MH_FL5	17.70 ±0.00	80.53 ±0.06	0.28 ±0.01	1356.39 ±0.00
MH_L1	18.70 ±0.00	79.33 ±0.29	0.34 ±0.00	711.66 ±0.00
MH_L2	18.00 ±0.00	80.30 ±0.00	0.46 ±0.10	680.44 ±0.00
MH_L3	16.90 ±0.00	81.33 ±0.06	0.31 ±0.07	735.68 ±0.00
MH_L4	21.20 ±0.00	77.23 ±0.06	0.31 ±0.06	549.68 ±0.00
MH_L5	16.50 ±0.00	81.80 ±0.10	0.35 ±0.07	806.78 ±0.00
MH_MV1	17.40 ±0.00	80.87 ±0.12	0.17 ±0.00	762.92 ±0.00
MH_MV2	17.30 ±0.00	80.97 ±0.06	0.18 ±0.00	1121.83 ±0.00
MH_MV3	14.60 ±0.00	83.60 ±0.00	0.15 ±0.00	512.86 ±0.00
MH_MV4	15.60 ±0.00	82.60 ±0.10	0.50 ±0.00	446.25 ±0.00
MH_MV5	17.70 ±0.00	80.63 ±0.06	0.22 ±0.05	883.04 ±0.00
MH_MV6	16.90 ±0.00	81.43 ±0.06	0.19 ±0.00	664.86 ±0.00
MH_MV7	15.90 ±0.00	82.40 ±0.10	0.31 ±0.00	958.07 ±0.00
MH_R1	18.90 ±0.00	79.37 ±0.12	0.38 ±0.04	750.18 ±0.00
MH_R2	16.90 ±0.00	81.33 ±0.06	0.71 ±0.02	1137.38 ±0.00
MH_R3	17.30 ±0.00	80.93 ±0.06	0.52 ±0.04	698.98 ±0.00
MH_S1	18.70 ±0.00	79.60 ±0.10	0.29 ±0.01	712.08 ±0.00
MH_S2	19.30 ±0.00	79.03 ±0.25	0.29 ±0.00	904.40 ±0.00
MH_S3	18.70 ±0.00	79.60 ±0.00	0.23 ±0.01	545.62 ±0.00
MH_T1	15.90 ±0.00	82.30 ±0.10	0.38 ±0.02	973.75 ±0.00
MH_TV1	16.00 ±0.00	82.27 ±0.12	0.42 ±0.00	1233.27 ±0.00
MH_TV2	17.90 ±0.00	80.30 ±0.00	0.40 ±0.01	742.11 ±0.00
MH_TV3	16.50 ±0.00	81.70 ±0.10	0.32 ±0.02	1177.56 ±0.00
MH_TV4	16.90 ±0.00	81.23 ±0.12	0.22 ±0.00	1162.43 ±0.00
MH_TV5	16.40 ±0.00	81.87 ±0.49	0.66 ±0.01	813.56 ±0.00
MH_TV6	16.10 ±0.00	82.17 ±0.21	0.39 ±0.09	801.64 ±0.00
PH Samples				
PH1	16.30 ±0.00	81.93 ±0.06	0.19 ±0.00	746.18 ±0.00
PH2	15.30 ±0.00	82.90 ±0.10	0.51 ±0.01	1352.52 ±0.00
PH3	15.50 ±0.00	82.80 ±0.00	0.77 ±0.02	622.49 ±0.00
PH4	18.10 ±0.00	80.17 ±0.06	0.21 ±0.01	988.10 ±0.00
PH5	15.10 ±0.00	83.20 ±0.10	0.22 ±0.01	792.53 ±0.00
PH6	18.70 ±0.00	79.60 ±0.10	0.36 ±0.00	1245.08 ±0.00
PH7	18.10 ±0.00	80.13 ±0.06	0.23 ±0.00	1231.61 ±0.00
PH8	16.50 ±0.00	81.80 ±0.10	0.19 ±0.01	938.58 ±0.00
PH9	16.90 ±0.00	81.30 ±0.00	0.25 ±0.00	858.29 ±0.00
PH10	19.10 ±0.00	79.23 ±0.06	0.23 ±0.00	467.15 ±0.00
PH11	18.10 ±0.00	80.30 ±0.10	0.30 ±0.00	1313.36 ±0.00
PH12	16.60 ±0.00	81.63 ±0.06	0.26 ±0.00	917.77 ±0.00
PH13	16.50 ±0.00	81.73 ±0.06	0.25 ±0.00	1258.06 ±0.00
PH14	16.00 ±0.00	82.23 ±0.06	0.36 ±0.01	1085.91 ±0.00
PH15	20.70 ±0.00	77.63 ±0.06	0.19 ±0.00	502.15 ±0.00
PH16	17.90 ±0.00	80.30 ±0.00	0.20 ±0.01	458.93 ±0.00
PH17	17.40 ±0.00	80.90 ±0.10	0.30 ±0.01	332.26 ±0.00
PH18	18.10 ±0.00	80.20 ±0.00	0.22 ±0.00	563.48 ±0.00
PH19	18.00 ±0.00	80.30 ±0.00	0.15 ±0.00	579.38 ±0.00

PH20	18.00 ±0.00	80.30 ±0.00	0.16 ±0.02	1146.22 ±0.00
HH Samples				
HH_H1	16.30 ±0.00	82.03 ±0.06	0.42 ±0.08	983.33 ±0.00
HH_H2	16.50 ±0.00	81.80 ±0.10	0.72 ±0.03	1247.56 ±0.00
HH_H3	15.80 ±0.00	82.43 ±0.06	0.44 ±0.13	1146.19 ±0.00
HH_H4	16.50 ±0.00	81.80 ±0.10	0.46 ±0.09	1151.17 ±0.00
HH_H5	16.90 ±0.00	81.30 ±0.10	0.58 ±0.12	925.12 ±0.00
HH_H6	15.90 ±0.00	82.30 ±0.10	0.42 ±0.00	1316.35 ±0.00
HH_H7	16.30 ±0.00	81.90 ±0.10	0.36 ±0.00	920.45 ±0.00
HH_H8	15.90 ±0.00	82.27 ±0.12	0.41 ±0.05	652.13 ±0.00
HH_H9	16.10 ±0.00	82.10 ±0.00	0.51 ±0.13	828.18 ±0.00
HH_H10	15.60 ±0.00	82.60 ±0.10	0.60 ±0.16	723.22 ±0.00
HH_H11	15.70 ±0.00	82.53 ±0.15	0.46 ±0.12	1142.93 ±0.00
HH_H12	16.50 ±0.00	81.80 ±0.10	0.61 ±0.15	571.91 ±0.00
HH_H13	16.70 ±0.00	81.53 ±0.06	0.79 ±0.01	905.14 ±0.00
HH_H14	17.10 ±0.00	81.23 ±0.06	0.49 ±0.03	982.02 ±0.00
HH_O1	16.90 ±0.00	81.33 ±0.06	0.59 ±0.10	1045.28 ±0.00

4 Conclusions

Consumers in every region of the world couldn't be sure about the safety of honey types due to changes in the honey processing, production and distribution processes, and these problems arising from honey are monitored more carefully by official authorities. In this context, 95 honey samples were analyzed under laboratory conditions using honey quality-control methods recommended in the literature It was concluded that the analyzed samples basically provide the desired quality standards. Moreover, the results obtained for the physical properties and proline content, indicate that most of the honeys have good quality grades, good freshness and ripeness, sufficient processing. It is obvious that the present study will contribute to researches based on honey safety.

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Conflict of interest

All authors declare that they have no further conflict of interest.

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