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A parameter for quality of honey

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Honey is used occasionally for sweetening infusions of black tea for improved palatability and believed health benefits. Naturally, this addition is not expected to adversely affect the wholesomeness of the tea. However, some samples of honey are reported to turn the colour of the tea infusion to an unappetizing tar-black, to the extent that it is considered unfit for human consumption. A thorough survey of the chemical composition suggests that the unusual high iron content may cause the blackening effect due to its association with polyphenolic tea compounds. © 1998 Elsevier Science Ltd. All rights reserved.

INTRODUCTION

Honey harvesting is an old industry in the Middle East. Today, in Israel, honey is supplied by some 500 beekepers who keep ca. 70 000 colonies at 6000 grazing sites primarily of wild-, citrus- and Eucalyptus blossoming. Among other traditional uses, honey occasionally replaces sugar for sweetening infusions of black tea for improved palatability and believed health benefits. Commonly, this addition does not affect the tea colour. During the last season, samples of honey that turned the colour of the tea infusion to an unappetizing tar-black, to the extent that it was considered unfit for human consumption, were brought to our attention. It was the aim of this study to identify the compositional parameter responsible for this effect.

MATERIALS AND METHODS

Samples

Seventy-two samples of raw, strained honey, harvested all over Israel during 1996, and few imported samples were provided by the Israeli Beekeepers Association.

Laboratory simulation of tea-blackening effect

The optical absorption of the tea infusion at 550 nm was arbitrarily chosen as an indicator of tea colour. In the standard procedure, one teabag of a commercial black tea blend was infused with stirring at 80°C for 5 min in 500 ml local mains water. The teabag was withdrawn and the infusion was employed for testing without delay. Typically, 25 ml tea was vigorously stirred with 1 g of honey and the optical absorbance at 550 nm was measured in a 1 cm cell. In control experiments, the honey was replaced with water. Triplicate experiments were carried out and the mean values are reported.

Compositional analysis

Samples (ca. 0.5 g honey) for mineral analysis were digested in 5 ml HNO_3 and made up to 25 ml with distilled water. The mineral content was determined by IPC, on a 'Spectroflame' instrument made by Spectro-Germany, calibrated with standards from Merck Co. Other chemical analyses were performed according to the described methods (Helrich, 1990).

RESULTS AND DISCUSSION

In order to correlate the reported 'tea blackening effect' to a compositional parameter of honey, all samples were analysed for chemical composition, including detailed mineral content, and subjected to the laboratory 'tea test'. The analytical results for 69 samples are summarized in Tables 1 and 2. Within the result ranges reported in these tables, no honey affected the tea undesirably. The only two samples of honey that caused discoloration of the tea were found to deviate from the usual composition only in regard to the iron content, which reached the unusually high values of 42 and 79 μg/g. These are ca. ten times higher than the average reported values of 2.4 ppm Fe in light honey, up to 9.4 ppm Fe in dark honey (White, 1975; Rodriguez-Otero *et al.*, 1994). Therefore it seems that the tea discoloration is due to the abnormally high content of iron and its association with polyphenolic tea compounds

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Table 1. Ranges of physico-chemical characteristics of Israeli honey

pH value	3.71–4.19
Total acidity (ml 1 N NaOH to 100 g honey)	1.02–4.78
Moisture (%)	15–17.8
Reducing sugars (%)	70.1–79.2
Glucose (%)	35.9–42.1
Apparent sucrose[a] (%)	2.72–10.12
Hydroxymethylfurfural (mg/100 g honey)	0.32–1.8
Diastase activity[a]	< 5–15

[a]Citrus honey is characterized by a temporary high level of sucrose (which drops to a lower value 2–3 weeks postharvesting), and low permanent diastase values.

Table 2. The mineral content of honey

Element	Concentration (μg/g)	Element	Concentration (μg/g)
Calcium	67–310	Titanium	0.1–0.4
Copper	0.1–0.9	Magnesium	16.5–53
Silicon	16–21	Nickel	0.3–1
Cadmium	< 0.6	Lead	< 6
Zinc	2.4–8.6	Silver	< 0.3
Vanadium	< 0.3	Chromium	< 0.3
Manganese	0.3–0.6	Cobalt	< 1
Potassium	420–1080	Lithium	< 0.3
Sodium	23–110	Barium	0.1–0.3
Strontium	0.2–1.1	Molybdenum	< 0.6
Selenium	< 1	Arsenic	< 0.4
Tin	< 1	Boron	1.5–13
Sulfur	31–66	Phosphorus	37–150
Iron	2.5–2.7	Aluminum	0.8–71

(Wilson and Clifford, 1992). Indeed, the intentional increase of the iron content from 2.5 to 50 μg/g in a sample of 'good' honey, by addition of $Fe_2(SO_4)_3$ in an aqueous solution, duplicated the 'tar-black' effect in tea (Table 3). The colour formation of the tea could be reversed by the addition of an excess of a chelating agent such as EDTA (ethylenediaminetetraacetic acid disodium salt), which sequesters the iron ions.

Table 3. Changes induced by addition of honey to an infusion of tea (± SD)

	pH[a]	OD_{550}
Tea	6.60	0.170 ± 0.016
Tea + honey (2.5 ppm iron)	6.48	0.172 ± 0.018
Tea + honey (42 ppm iron)	6.50	0.33 ± 0.020
Tea + honey (79 ppm iron)	6.52	0.345 + 0.029
Tea + honey (2.5 ppm iron) + 47.5 ppm $Fe_2(SO_4)_3$	5.90	0.329 ± 0.024

[a]Standard deviation < 0.01.

No explanation can be provided for the occurrence of the abnormal iron content in honey samples, except for an accidental contamination due to contact with unprotected metal surfaces.

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