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Chemical quality of strained honey consumed in Ankara*

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Summary: The present study was conducted for the determination of some chemical quality and suitability of the 70 strained honey samples (35 flower honey and 35 pine honey). The findings were evaluated by using Honey Standard presented in the Turkish Honey Regulation (Turkish Food Codex, Honey Directive) All the samples collected from local retailers in Ankara were analysed for their humidity, acidity, diastase activity, hydroxymethyl furfural, invert sugar, sucrose, commercial glucose, ash, starch and pollen contents. 80 % of floral honey and 31.43 % of pine honey samples were laid down by the Turkish standard. According to the pollen analyse results 5.71 % of floral honey samples included rhododendron pollens. As a result, control of the honey sold in Ankara should be analysed more usually than before from farm to table both for the protection of public health and consumer rights.

Key words: Honey, honeydew honey, flower honey, chemical quality

Ankara'da tüketime sunulan süzme balların kimyasal kaliteleri

Özet: Bu çalışma, Ankara'da tüketime sunulan süzme balların bazı kimyasal özellikleri yönünden kalitelerini ve Türk Gıda Kodeksi Bal Tebliğine uygunluklarını belirlemek amacıyla yapılmıştır. Bu kapsamda, analize alınan 35 süzme çiçek ve 35 süzme çam balı örneği olmak üzere toplam 70 süzme bal örneği rutubet miktarı, asitlik, diastaz sayısı, hidroksimetil furfurol, invert şeker, sakkaroz, ticari glikoz, kül, nişasta ve polen yönünden incelenmiştir. Analiz sonuçlarına göre çiçek balı örneklerinden % 80'ninin, çam balı örneklerinden % 31.43'ünün Türk Gıda Kodeksi Bal Tebliğine uygun olmadığı belirlenmiştir. Yapılan polen analizinde çiçek ballarının % 5.71'inde rhododendron polenleri saptanmıştır. Sonuç olarak Ankara'da tüketime sunulan süzme balların üretiminde yetiştiricinin bilgilendirilmesinin, üretim ve satış aşamalarında denetimin arttırılmasının halk sağlığının ve tüketici haklarının korunması açısından gerekli olduğu görüşüne varılmıştır.

Anahtar sözcükler: Bal, çam balı, çiçek balı, kimyasal kalite.

Introduction

Honey is the natural sweet substance produced by honeybees from the nectar of blossoms or from secretions of living parts of plants or excretions which honeybees (*Apis mellifera, Apis mellifica*) collect, transform and combine with specific substances of their own, store and leave in the honey comb to ripen and mature (3).

Chemical composition of the honey shows differences depanding on many factors. The most important of these factors is the natural combination of the nectar and secretion. Also climatic conditions and the capability of the bees in making honey are the effective factors on the composition (15). Table 1 shows chemical parameters regarding the Turkish Food Codex Honey Communicating.

Water content in the honeys is important only for determining the quality and fermentation. Temperature and humidity where honey is stored, processing methods of the honey and air circulation can cause in the moisture content of honey (15). The water content of honey should be less than 20 %. If it is higher than this, it is readily susceptible to fermentation by osmophilic yeasts (11,16).

Table 1. Chemical parameters detected for honeys (4,5,7,8).
Tablo 1. Ballar için belirlenmiş kimyasal özellikler (4,5,7,8).

Chemical parameters	Range/s
Humidity	≤ 20 %
Total acidity	≤ 50 meq/kg
Diastase activity	8 ≤
HMF	≤ 40 mg/kg
Invert sugar	Flower honey: 60 % ≤ Pine honey: 45 % ≤
Sucrose	Flower honey: ≤ 5 % Pine honey: ≤ 10 %
Ash	Flower honey: ≤ 0.6 % Pine honey: ≤ 1.2%
Commercial glucose	Should not be found
Starch	Should not be found

Basic composition of the honey is carbohydrate. From these fructose and glucose are most commenly found. The composition of disaccharides depends largely on the plants from which the honey is derived (11,21,30). In a very few honeys such as brassica napus rape, chicory (*Cichorium intybus*) and blue curl (loch) glucose is found

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more than fructose. In all of the other honeys, fructose content is more than glucose. These two sugars represent 69 % - 78 % of carbohydrates in honey. The amount of sucrose in honey differs according to the maturity degree and nectar compound of the honey. Unripened honeys that are very early harvested, contain too much sucrose. Depending on the latter, a trick comes to mind as the sucrose is more than the amount stated in the honey standard (11,29,30,).

Honey is rich regarding the enzymes. Honey enzymes, as an indicator are representing the quality of the honey. The most prominent enzymes in honey are α-glucosidase (invertase or saccharose), α- and β-amylases (diastase), glucose oxidase, catalase and acid phosphatase (11).

5-hydroxymethyl-2-furaldehyde (HMF) on of the important quality criteria in honey, is formed by dehydration of fructose and glucose (19). During the storage HMF is forming in different rates from the hexose sugar depending on the honey pH and heat in acid eficacy (14). High HMF content (40mg/kg or more) indicates whether the honey is heated and/or sucrose, hydralysed with acid or cornflower syrup is added to the honey (20). It is reported that if honey is kept 25 °C for one year, in 60 °C for three days, HMF forming is in the level of 3.0 mg/100g (19).

Honey is the most trickery animal product because of its processing ways and compound. According to the Turkish Standards 3036 (3), tricky honey is the honey that had lost its general feature because of some foreign substances such as water, milk, starch, mellas syrup, flour, glue, plaster, chalk, gelatin, gel, colour and aroma substances are added. Especially well-sugared honey obtained as a result of bees feeding up with mellas syrup, hold an important position in tricky honey (12,15,24).

Determination of the chemical qualities of the honey are important regarding the protection of public health and consumer rights. The present study was conducted in order to determine the suitability of the strained honey presented for consumption in Ankara chemically regarding the Turkish Food Codex Honey Communicating.

Materials and Methods

In this study, 35 strained flower honey and 35 strained pine honey, total 70 strained honey samples from different district markets in Ankara were collected to use as materials. The samples were put in glass jars in approximately 300g each.

Moisture content was measured using a refractometer (2) and free acidity was determined by the titrimetric method. Diastase measures held by the starch hydrolysis activity of diastase enzyme. Hydroxy-methylfurfural was determined by spectrophotometric method. Invert sugar determination was done in basic condition within the titration of Zinc (II) solution against methylene blue indicator. Sucrose determination was done by the titration as methylene blue indicator against reduced sugar solution. Founded total sugar percentage was reduced within the invert sugar percentage and then multiplied by 0.95 rotating factor. The presence of commercial glucose was detected by iodine and/or fiche method (3). Ash percentage was determined by calcination in a furnace (6). Starch determination was performed by iodine method (15). Pollen analyse was done by microscopic inspection (27).

Results and Discussions

Table 2 and Table 3 shows the chemical results of 35 strained flower honey samples and 35 strained pine honey samples, total 70 strained honey samples.

Except the values given in Table 3 starch was found in the 7 of the flower honey samples. 8 flower honey samples gave possitive reaction by iodine method and 6 flower honey samples gave positive reaction by fiche method during commercial glucose determination. No pollen was seen in 2 flower honey samples and rhodo-dendron pollens were seen in 2 flower honey samples.

Only one of the samples which was a pine honey contained starch. Commercial glucose analysed with Iode and Fiche methods and only one pine honey sample showed to contain commercial glucose with Fiche method.

In this study, diastase activity was found lower than the results reported by White (30), Velioğlu and Köse (28) and Devillers et al. (13); but higher than the results

Table 2. The results of chemical analysis of flower honeys.
Tablo 2. Çiçek ballarının kimyasal analiz sonuçları

	Minimum	Maximum	Mean	Standard deviation	Standard error
Humidity (%)	13.0	25.0	16.3	2.06	0.348
Acidity (meq/kg)	8.23	33.21	24.464	5.88	0.993
HMF (mg/kg)	11.133	256.27	74.51	72.02	12.166
Diastase activity	0	29.4	11.58	8.96	1.514
Invert sugar (%)	23.47	89.29	70.48	10.99	1.856
Sucrose	0	23.64	5.28	4.83	0.816
Ash (%)	0.11	0.72	0.37	0.15	0.025

Table 3. The results of chemical analysis of pine honeys
Tablo 3. Çam ballarının kimyasal analiz sonuçları

	Minimum	Maximum	Mean	Standard deviation	Standard error
Humidity (%)	13	17.4	15.62	1.16	0.196
Acidity (meq/kg)	17.43	40.88	26.89	5.24	0.885
HMF (mg/kg)	5.88	125.32	21.50	19.50	3.294
Diastase activity	1	38.5	25.14	9.71	1.640
Invert Sugar (%)	61.96	81.27	71.56	5.14	0.868
Sucrose	0	16.82	4.64	5.21	0.880
Ash (%)	0.18	0.75	0.44	0.13	0.022

reported by Tolon (25) and showed similarity with Aydoğan et al. (9), Tosun (26) and Şahinler et al. (22). In a previous study by Şahinler et al. (22) 44 % out of 50 honey samples examined, were not reported to be suitable regarding the Turkish Honey Codex. The present study, in accordance with the study reported by Şahinler et al. (22) showed similarities. Enzymes, like diastase, play an important role in the biological value of honey. Exposure to high temperatures and long storage periods inactivate diastase. In the present study as in 14 honey samples diastase activities were recorded very low besides HMF counts were very high showed that these honey samples were treated with high temperature. Besides, as these samples displayed commercially available glucose, except one, coincided that these samples were tricky honeys.

In our study, HMF values were higher than all the other sources published by many scientists (1,9,13,22,25,26,28). This difference may be from the commercial glucose content in the 40 % of floral honey samples and 2.86 % of pine honey samples, total 21.43 % of the samples, not only the HMF amounts were high but also diastase activity was low, showed that these honey samples had high temperature applications.

Sucrose values detected in the present study was higher than reported by White et al. (29), Tetik (24), Balcı (10), Velioğlu and Köse (28), Aydoğan et al. (9), Şahinler et al.(22) and Devillers et al. (13); however was in association with Kurt and Yamankaradeniz (17), Tolon (25) and Tosun (26). This difference indicates that honeys contain sugar, bees were fed with sugar solution insted of nectars, early harvesting before honey ripenned in the honeycomb and false acacia (*Robina pseudoacacia*), alfalfa (*Medicago sativa*), (*Banksia menziesii*) flower honeys, honeysuckle (*Hedsaryum*), redgum (*Eucalyptus camadulensis*), leather wood (*Eucryphia lucida, Eucryphia milliganii*) origin honeys and orange honeys have been mixed.

Commercial glucose was determined in 14 flower honey (40 %) samples and in 1 pine honey sample (2.86 %) that were analysed. Tetik (24), Kurt and Yamankaradeniz (17) and Tolon (25) didn't report commercial glucose in any of the honey samples they examined. Tosun (26) has reported that 7 out of 30 samples (23.3 %) contain commercial glucose. The ratios of commercial glucose were found in our study are higher than found by Tosun (26). Regarding the Turkish Food Codex Honey Communicating (4,5,7,8), commercial glucose should not be included in honey. That's why 15 (21.43 %) honey samples which contain commercial glucose are adulterate.

Seven of the floral honey samples (20 %) and 1 pine honey sample (2.86 %) contained starch. In the study done by Tetik (24), Aydoğan et al. (9) and Tosun (26) no starch was reported in the samples they analysed. According to the Turkish Food Codex Honey Communicating (4,5,7,8), there should be no starch in honey. In consideration samples containing starch is not suitable with the Turkish Food Codex Honey Communicating and should be included in tricky honeys.

Ash values examined in this study was higher than the values reported by White (2), Kurt and Yamankaradeniz (17) and Velioğlu and Köse (28) and shows similarity with the values reported by Tetik (24), Şengonca and Temiz (23), Tolon (25) and Ojeda de Rodriguez et al. (18). These differences depend on either the composition of nectars from various botanical origin or honeydew honey mixed into floral honeys.

In the present study, pollen analyse was not performed for determination of flower varieties, which were the sources of honey as botanic, however performed for determination of presence of pollen and poisonous pollen in honeys. In the present study poisonous rhododendron pollens were detected in 2 (5.71 %) of floral honeys. Besides in the 2 (5.71 %) samples, no pollen has been seen. In previous studies dealing with the detection of pollen and poisonous pollen presence, Aydoğan et al. (9) did not record poisonous pollen. Tetik (24) had reported poisonous pollens prominently in Blacksea region honeys and in other honeys with a few specialized pollens. In the present research the reason why pollen was not included in 2 honey samples, considered that these honeys may be filtered or were not natural or were tricky.

As a result, it was considered that the commercially available honeys presented in Ankara for consumption had various qualities, some parts including diastase activity below the limits HMF counts much alow the

limits that were important signified factors regarding the biological importance and including poisonous pollens. Commercial glucose and starch can not be contained in a honey sample according to the regulations and both were found especially in floral honeys. Due to the analysis held 80 % of floral honey samples and 31.43 % of pine honey samples were not acceptable by the regulations of Turkish Food Codex Honey Communicating. These honey samples included significantly high levels of sucrose which would be caused by the bee feeding with corn and mellas syrup. The beekeepers producing strained honeys that consumed in Ankara, should be well educated. It's a necessity to control the honeys from farm to table both for the prevention of public health hazards and in the name of consumer rights.

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