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ORIGINAL ARTICLE

Physicochemical characteristics, total phenols and pigments of national and international honeys in Saudi Arabia

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Abstract In 23 types of honey from Saudi Arabia and six other countries, the levels of some minor components and floral pigments as well as physicochemical characteristics were investigated. Most tested Saudi honeys, *e.g.* Acacia and Seder showed high values of density and total soluble solids and low water content compared to exotic ones. Some Acacia and Manuka samples had higher HMF contents than permitted levels. All the tested honeys were acidic; however Acacia honey had total acidity values over those of permitted levels, while most of the remainding types were comparable or acceptable. Also, Saudi Acacia and Egyptian honeys contained more content of total nitrogen, free amino acids and proline than those of the other tested types. Dark-colored honeys *e.g.* Acacia contained more phenolic content than those of the light-colored ones. Carotenoids were the predominant floral pigments in all the tested honeys, while xanthophylls and anthocyanins were the least predominant ones. Seder honeys showed moderate values of the tested characteristics compared to other types. The tested parameters are useful to determine the botanical origin of Saudi or exotic honeys and their quality. Further research on specific physicochemical properties of Saudi Acacia honey especially acidity is very much recommended. New criteria based on the regional characteristics of Saudi honeys including antioxidants, micro-constituents are suggested.

1. Introduction

Determination of the standard criteria of food products is the most important process, since consumption, quality and validity of these products depend on it. Also, purity and contaminant-free food are other factors of great concern for consumer health. Honey is one of the most important global natural products. Honey comes in the first order of these products, since it has many benefits in foods, and medicine. Honey, generally contains, on average, water (20%), monosaccharides

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(75% fructose and glucose), disaccharides (3–10% sucrose), complex sugars and other materials, *e.g.* proteins, vitamins, enzymes and minerals (Celechovska, 2002 and Serrano et al., 2007). Honey also contains important components *e.g.* antioxidants (Berettaa et al., 2005; Baltac et al., 2006 and Bertoncelj et al., 2007). Some reports mentioned that honey contains more than 200 components (Kucuk et al., 2007). Since honey types differ from one country to another and in different regions in the same country due to floral origin, soil composition and other factors consequently, quality criteria differ from one honey type to another, *i.e.* blossom honey is greatly different than the honeydew one. So these criteria vary according to these factors and need to be periodically revised with updating methodologies, as local and global standards change, *e.g.* the permitted level of hydroxymethylfurfural (a toxic material produced in overheating and/or long storage of honey) was formerly 40 mg/kg, this level was suggested to be 60 mg/kg (CAC, 1998).

In Arab countries honey has the first rank in folk medicine. In Saudi Arabia, the consumption of honey is increasing, since it is one of the principle ingredients in foods, as remedy and in natural mixtures (Alqarni, 2011). There are many types of honey (local and exotic) commonly consumed in Saudi Arabia. Most of these honeys are traded without quality sign or reference to their origins and this may lead to honey adulteration and/or marketing non-standard honeys. So, comparing these honeys with quality standards is greatly required. Also, some preliminary reports mentioned that Saudi Acacia honey has over permitted acidity levels. This suggestion needs to be explained (Alqarni, unpublished data).

Although, previous studies which were conducted on Saudi honeys focused on physiochemical characteristics, minerals content, pollen spectrum, and antimicrobial activity (Mesallam and El-Shaarawy, 1987; Abu-Tarboush et al., 1992; Al-Khalifa and Al-Arify, 1999; Al-Doghairi et al., 2007; Ashraf and Akram, 2008), they did not deal with other important constituents. In this study we determined some minor constituents of Saudi and exotic honeys, *i.e.* floral pigments, proline, total amino acids and total phenolic contents. We propose these measurements as "chemometrics" or markers of quality criteria for Saudi and exotic honeys, as well as ordinary characteristics listed in the national and international standards.

2. Experimental

Native and exotic honeys (23 samples from Saudi Arabia and 6 countries) were tested. Thirteen samples were collected from local honey producers at different regions of Saudi Arabia (11 samples are floral and 2 from artificially-fed colonies). Out of the exotic samples, 3 were from Egypt, 2 from New

Table 1 Types and regional data of the 23 tested honey samples.

Codes*	Honey types (Scientific names)	Area of production and year
ACS1	Acacia Saudi Honey 1 (*Acacia* spp.)	South KSA (Stored honey)
ACS2	Acacia Saudi Honey 2 (*A.* spp.)	Middle KSA 2009
ACS3	Acacia Saudi Honey 3 (*A.* spp.)	Shouaib Al-sahl, KSA 2009
SMS	Somrah (*A. tortalis*)	Al-Taif, Southwestern KSA (Stored honey)
SDS1	Seder (*Ziziphus spina-christi*)	South KSA 2009
SDS2	Seder (*Z. spina-christi*)	Rawdha Al-Hashim, KSA 2009
SDS3	Seder (*Z. spina-christi*)	Al-Taif, Southwestern KSA 2009
SHS	Shefallah (*Capparis* spp.)	Shouaib Tarif, KSA 2010
ALS	Alfalfa (*Medicago sativa*)	Al-Ghowailk farm, KSA 2010
MFS1	Multifloral (various flowers)	Diyrab[e], South Riyadh, KSA 2010
MFS2	Multifloral (various flowers)	Diyrab, South Riyadh, KSA (Stored honey)
ARS1	Artificially-fed colonies[a]	Diriyah, BRU[d], Riyadh, KSA 2010
ARS2	Artificially-fed colonies[b]	Diriyah, BRU, Riyadh, KSA 2010
SDY	Seder (*Z. spina-christi*)	Hadramout, Yemen 2009
CTE	Citrus (*Citrus* spp.)	Qalibubia governorate, Egypt 2010
CVE	Clover (*Trifolium alexnadrinum*)	Fayoum gov., Egypt 2010
CNE	Cotton (*Gossypium barbadense*)	Fayoum gov.,Egypt 2010
MKN1	Manuka UMF[c] 18% (*Leptospermum* spp.)	New Zealand 2009
MKN2	Manuka UMF 10% (*L.* spp.)	New Zealand 2009
BFG	Black Forest (forest trees)	Germany 2009
PAG	Pseudoacacia (*Rhobinia pseudoacacia*)	Germany 2009
JRA	Jarrah (*Eucalyptus marginata*)	Australia 2009
TUM	Tualang (*Koompassia excels*)	Malaysia 2009

[a] *A. m. yemenitica* colonies.
[b] *A. m. carnica* colonies.
[c] unique manuka factor.
[d] Bee Research Unit, King Saud University, KSA.
[e] Educational Farm of College of Food and Agric. Sci., KSU, KSA.
* ACS1,2,3 (*Acacia gerardii* honey from 3 locations, KSA), BFG (Black forest honey, Germany), SMS (*Acacia tortilis* honey, KSA), MKN 1&2 (Manuka honey 18% and 10% UFM, New Zealand), MFS 1&2 (Multifloral honeys 1&2, KSA) SHS (Shafallah- caper bush- honey, *Capparis spinosa*, KSA), SDS1,2,3 (Seder, *Ziziphus* sp. honey from 3 locations, KSA), SDY (Seder, *Z. sp.* honey, Yemen), TUM (Tualang tree Koompassia excelsa honey, Malaysia), CNE (Cotton honey, Egypt), JRA (Jarrah, Eucalyptus marginata honey, Australia), CVE (Clover honey, Egypt), PAG (Pseudoacacia trees, Robinia pseudoacacia honey, Germany), ARS 1&2 (Artificially fed colonies honey 1&2, KSA), CTE (Citrus honey, Egypt), and ALS (Alfalfa honey, KSA).