Food Chemistry 262 (2018) 162–167

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Quality evaluation of Omani honey

Mohamed Al-Farsi*, Sharifa Al-Belushi, Abeer Al-Amri, Ahlam Al-Hadhrami, Mahfoodha Al-Rusheidi, Amani Al-Alawi

Food & Water Lab. Center, Ministry of Regional Municipalities & Water Resources, P O Box 323, P C 100, Muscat, Oman

ARTICLE INFO

Keywords:
Standards
Moisture
Acidity
Diastase
Sugars
HMF

ABSTRACT

This study was intended to evaluate the quality parameters of 58 *Apis mellifera* honey samples, from different regions in the Sultanate of Oman. Physicochemical analyses were carried out and examined according to the Gulf Standardization Organization (GSO).

The results revealed that 64.4% of the samples were failing to meet the GSO standards due to acidity, hydroxyl methyl furfural (HMF), diastase, sucrose, and glucose & fructose. Acidity and HMF were above the limits in 30% and 29% of the failed samples respectively, where diastase and total glucose & fructose were below the limits in 25% and 5% respectively. Sucrose was above the limits in 11% of the failed samples.

The unconformity of the analyzed honey samples to GSO standards could be due to stage of harvesting, process and storage conditions. Therefore, it's important to reconsider the whole process of honey production in Oman in order to improve the technology and honey quality.

1. Introduction

Oman is an important honey-producing contrary in the Arabian Peninsula, with production reached 600 metric tons in the year 2016 (Annual Report, 2017). Honey is a natural product produced by honey bees, being part of the human diet since ancient times. The Omani honey is produced mostly by two species of bees, *Apis florea* and *Apis mellifera* (Sajwani, Eltayeb, Farook, & Patzelt, 2007). It is produced from the nectar or secretions of living parts of plants, collected and transformed by bees, deposited, dehydrated and stored in honeycombs. Honey regards as the most important product of beekeeping both from quantitative and economic points of view (Krell, 1996). The composition of honey can vary widely depending on the region, season, bee variety, plant source of nectar and storage time in the honeycomb as well as the mode of harvesting and post-harvest storage (Singhal, Kulkarni & Rege, 1997).

Honey is mainly composed of sugars (70–85%), the majority of these (85–95%) are simple sugars, namely, fructose and glucose. Water is the second largest component in honey (15–20%) and its content can be influenced by the botanical origin of the nectar, climatic conditions and the handling during the harvesting of honey (Krell, 1996). The water content is considered one of the most important features as it affects several characteristics of honey, such as viscosity, specific weight, maturity, flavor and crystallization (Silva, Santos, Silva, Queiroz, & Lima, 2010). In addition, honey contains several minor components such as proteins, minerals, enzymes, vitamins, organic acids and phenolic compounds (Roshan et al., 2017). Organic acids are the most important minor constituents of honey, among which gluconic acid, a by-product of enzymatic digestion of glucose, predominates. Organic acids are responsible for the acidity of honey and contribute largely to its characteristic taste (Krell, 1996).

Proteins, enzymes and water-soluble vitamins are thought to result from pollen contents and from honeybee secretions in honey (Krell, 1996). Draiaia, Rezki, Ben nacer, and Chefrour, (2014) reported the protein content in Algerian honey which ranged between 0.09% and 0.81%. Honey contains a few amounts of amino acids and proline is the most important. It represents 50–85% with respect to other amino acids in honey (Bonvehi & Jorda, 1997). The analysis of proline in honey should indicate the determination of ripeness and originality. The main enzymes in honey are invertase, diastase (amylase) and glucose oxidase (Krell, 1996). These enzymes secreted from the salivary of worker honeybees and play an important role in converting the nectar to honey.

Hydroxy Methyl Furfural (HMF) is the most consistent indicator of honey freshness as it's practically absent in freshly harvested honey. It's formed from degradation of sugars, mainly from fructose, which is thermally more labile than sucrose and glucose (Belitz & Grosch, 1992). However, it increases during handling, extraction, conditioning, or storage operations and also as a consequence of the liquefaction and pasteurization carried out to improve manageability and destroy the

* Corresponding author.
E-mail address: malfarsi61@gmail.com (M. Al-Farsi).

https://doi.org/10.1016/j.foodchem.2018.04.104
Received 1 February 2018; Received in revised form 21 April 2018; Accepted 23 April 2018
Available online 24 April 2018

crystallization nuclei (Visquert, Vargas, & Escriche, 2014).

Antimicrobial effects of honey against disease or infection have been reported and honey biological activity has been attributed not only to the high sugar concentration but also to different compounds such as acids, phenolics, proteins, vitamins and mineral (Rodriguez, Mendoza, Iturriga, & Castano-Tostado, 2012). Although honey is considered a natural and health beneficial product with a high economic value, it can have different commercial value depending on it's botanical and geographical origins. The monofloral honey, which arises from a single botanical origin, being perceived as a high qualitative honey with distinct characteristics (Soares, Amaral, Oliveira, & Mafra, 2015). In Oman, there are two main florals for honey, the summer floral *Acacia tortilis* (Forssk) belong to the family Fabaceae, which called Sumer in Oman, and the winter *Ziziphus spina-Christi* (L) belong to the family Rhamnaceae, called Sidr (Sajwani et al., 2007). However, previous studies have shown that quality and biochemical properties of honey are related not only with the botanical and geographical origin but also with honey maturity, climatic conditions, processing and storage conditions (Da Silva, Gauche, Gonzaga, Costa, & Fett, 2016).

To preserve the safety and health effects of honey to consumers, it is important to ensure the quality and authenticity of honey. Therefore, certain quality criteria for honey been proposed by the International Honey Commission includes moisture content, reducing sugars, sucrose content, electrical conductivity, minerals, free acidity and HMF (IHC, 2009). According to the Gulf Standardization Organization (GSO), honey products in the Gulf countries should comply with the mandatory specification GSO 147 (GSO, 2008). Honey adulteration is an illegal practice which incorporates sugar syrups such as sucrose, corn syrup and molasses into the genuine honey. It's also caused by incorporation of sugars into honey via feeding of bees as well as selling honey under a fraudulent origin name (Cordella, Militão, Clément, Drajnudel, & Cabrol-Bass, 2005). The honey adulteration is causing serious impact on the local and international market opportunities of the product and results in nutritional and health difficulties on consumers (Ayansola & Banjo, 2011).

In the last few years, the exportation and importation of honey have been growing in Oman, it's valued 0.61 and 6.34 million US dollars respectively in the year 2015 (Year Book, 2016). Although several studies worldwide were performed on physicochemical parameters and biological compounds of honey (Sajwani et al., 2007; Karimov, Xalilzad, Hobbi, & Alekperov, 2014; Soares, Pinto, Rodrigues, Alves, & Oliveira, 2017), no studies evaluated the quality of Omani honey to the GSO standard. The GSO standard for honey is a mandatory specification and all honey either imported or exported from Oman has to comply with this standard, which has similar specification to the international legislation.

The main objectives of this study were to evaluate the quality parameters of Omani honey and verifying their compliance with GSO standard. In this work, 58 Omani honey samples from 18 different geographical origins, produced in 2016, were evaluated regarding different quality parameters such as moisture, acidity, sugars, insoluble matter, diastase and HMF.

2. Materials & methods

2.1. Honey samples

Honey of *Apis mellifera* honeybee used in this study was from 18 honey producing regions in the Sultanate of Oman. The 58 samples (29 Sidr, 21 Sumer and 8 multiflora) were collected from Honey exhibition which organized by the Ministry of Agriculture and Fisheries in December 2016. Table 1 shows the locations, types and numbers of these samples. The samples were stored at room temperature in a dark place until analyses, which took 6 months to finish.

Table 1
Location, type and numbers of honey samples.

Location	Type	Number of samples
Dema w Thaieen/Northeastern	Sumer, Sidr	2
Al Awabi/Batinah South	Sumer, Sidr	3
Al Hawqayn/Batinah South	Sumer, Sidr	2
Rustaq/Batinah South	Sumer, Sidr, multiflora	5
Sohar/Batinah North	Sumer, Sidr, multiflora	4
Shinas/Batinah North	Sumer, Sidr, multiflora	3
Khaboura/Batinah North	Sumer, Sidr, multiflora	4
Nizwa/Interior	Sidr	2
Samail/Interior	Sumer, Sidr, multiflora	7
Al Hamra/Interior	Sumer, Sidr	2
Izki/Interior	Sumer, Sidr, multiflora	4
Ibri/Dhahirah	Sumer, Sidr	5
Ibra/Northeastern	Sumer, sidr, multiflora	5
Al-Mudhaibi/Northeastern	Sidr	1
Bidiya/Northeastern	Sumer, Sidr,	3
Bani Khalid/Northeastern	Sumer, Sidr, multiflora	3
Al Seeb/Muscat	Sidr,	1
Mahdah/Buraimi	Sumer, Sidr	2
Total Samples		58

2.2. Moisture and total soluble solids (Brix)

Moisture and total soluble solids parameters (°Brix) were measured according to the International Honey Commission (IHC), 2009. Refractometer (Abbe 60 Refractometer, Bellingham Stanley, Kent, UK) was used to measure directly the refractive index and °Brix at 20 °C.

2.3. Acidity and pH

The acidity and pH of samples were determined according to the IHC (2009), 10 g sample was dissolved in 75 ml of carbon dioxide free water in 250 ml beaker. The pH measured by pH meter (Mettler Toledo) and the solution titrated with 0.1 N sodium hydroxide solution to pH 8.3. The acidity of honey represents the content of all free acids and expressed in meq/kg honey.

2.4. Sugar contents

Ion Chromatography (IC) method was used to determine the sugar contents (glucose, fructose and sucrose) of honey according to Hostettler, Brogioli, Arpagaus, Müller-Werner, and Jensen (2016). After dilution of sample and filtration, the sugar content was determined by Dionex IC 3000 and electrochemical detector using Dionex Carbopac PA20 (3× 150 mm) as a separation column. Peaks were identified on the basis of their retention times. Quantitation was performed according to an external standard method on peak areas.

2.5. Insoluble matter

The insoluble matter was determined according to the IHC (2009); accurately 20 g of honey dissolved in 200 ml of water at about 80 °C and mixed well. The honey solution was filtered through the weighed crucible and washed carefully and extensively with warm water until free from sugars. The crucible dried at 135°C for an hour, cooled in a desiccator and weighed.

2.6. Diastase activity

Diastase refers to any α-, β-, or γ-amylase that can break down sugars. It's measured by a photometric method according to IHC (2009), in which an insoluble blue dyed cross-linked type of starch (Phadebas, Magle Life Sci., USA) is used as the substrate. This is hydrolyzed by the enzyme in honey, yielding blue water-soluble fragments which determined by spectrophotometer at 620 nm. The absorbance of the