

CHANGES IN α -AMYLASE ACTIVITY IN HONEY DURING THE FREEZE-DRYING PROCESS

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Abstract

Honey is a natural product, which is appreciated for its sweetness, high nutritional value and health benefits all over the world. Despite all benefits, the usage of honey in food industry is limited due to its high viscosity and tendency to crystallize. The use of dehydrated honey could be an alternative to liquid honey. The dehydrated honey provides many advantages: extended shelf-life, ease of packing and transporting, ease of use in food industry. It could be used as an additive in a range of many different food products, for example, in sauces, beverages, yogurts.

Honey powder can be produced by different drying methods. Freeze-drying is one of drying techniques that can be used to obtain honey-rich powder. The method is gentle and allows to preserve bioactive compounds during the drying process. The usage of freeze-drying allows to produce high quality dry food products.

The quality of honey as a food product is very important. The enzymatic activity of honey is one of the indicators to detect its freshness and quality. Honey contains various enzymes such as saccharase (invertase), glucose oxidase, catalase, peroxidase and α -amylase (diastase). α -amylase is predominant enzyme in honey and its activity changes during the thermal processing of honey. α -amylase activity along with hydroxymethylfurfural (HMF) are used to detect the quality of honey. The high-quality honey shows high α -amylase activity and low hydroxymethylfurfural concentration.

The aim of the present study was to investigate and compare α -amylase activity in liquid honey samples and freeze-dried honey samples.

Materials and methods

Overall, eighteen honey samples were used for freeze-drying experiments. Ten honey samples were derived from Latvian beekeepers in 2018 and 2019 from different districts in Latvia. Four honey samples were purchased from a local supermarket in Jelgava, Latvia in 2018. Another four honey samples were purchased in local markets and supermarkets in Estonia, Italy, Hungary and Tajikistan in 2018 and 2019.

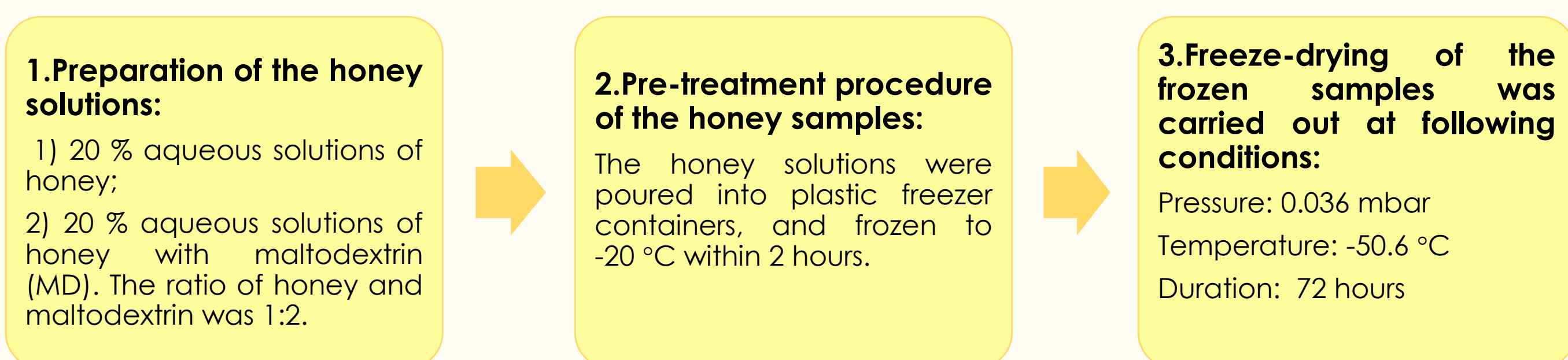


Figure 1 The obtaining of dehydrated honey samples

- Moisture content in liquid honey and freeze-dried honey samples was determined using a moisture analyzer AND MX-50 (A&D Company, Limited, Japan).
- Determination of α -amylase activity in liquid honey and freeze-dried honey samples was carried out according to Amylzyme assay procedure.
- Detection of the concentration of hydroxymethylfurfural (HMF) in the samples was performed on Shimadzu LC-20 Prominence liquid chromatograph (Shimadzu USA Manufacturing Inc, Canby, USA) with a Shimadzu DAD SPD-M20A detector. Analytical column PerkinElmer C18 (4.6 mm \times 250 mm I.D., particle size 5 μ m) was used for the analysis. Column and detector temperature were set to 25 °C. The mixture of acetonitrile (HPLC grade, Sigma-Aldrich) and water (HPLC grade) was used as a mobile phase.

Results

During the freeze-drying process water was removed from frozen honey solutions by sublimation. The dehydration of the honey samples was carried out using two kind of formulations. The obtained samples showed a decrease in moisture content after the 72-hours-long freeze-drying process (Fig. 2 and Fig. 3).

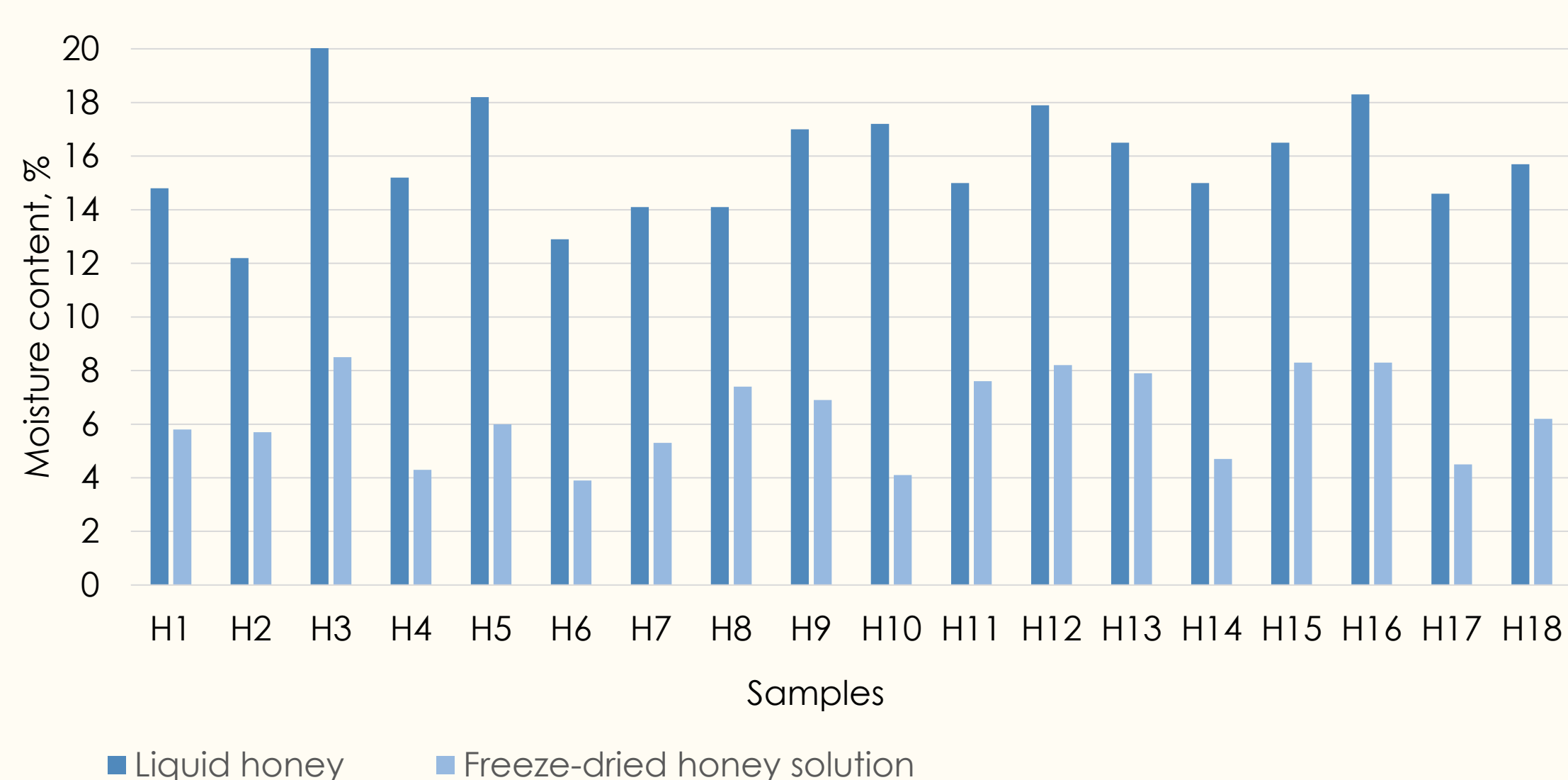


Figure 2 Moisture content in liquid honey and freeze-dried honey samples

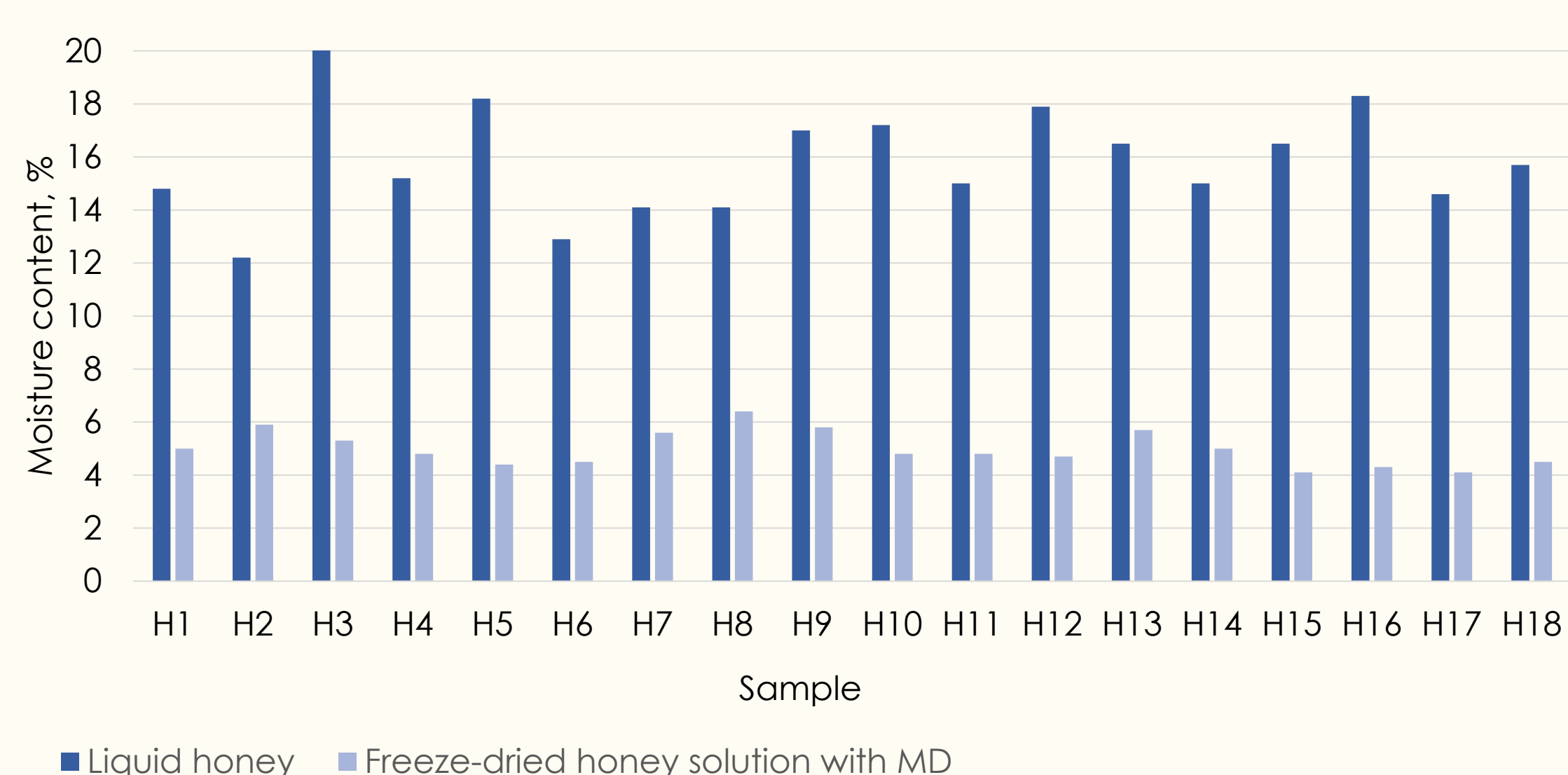


Figure 3 Moisture content in liquid honey and freeze-dried honey with MD samples

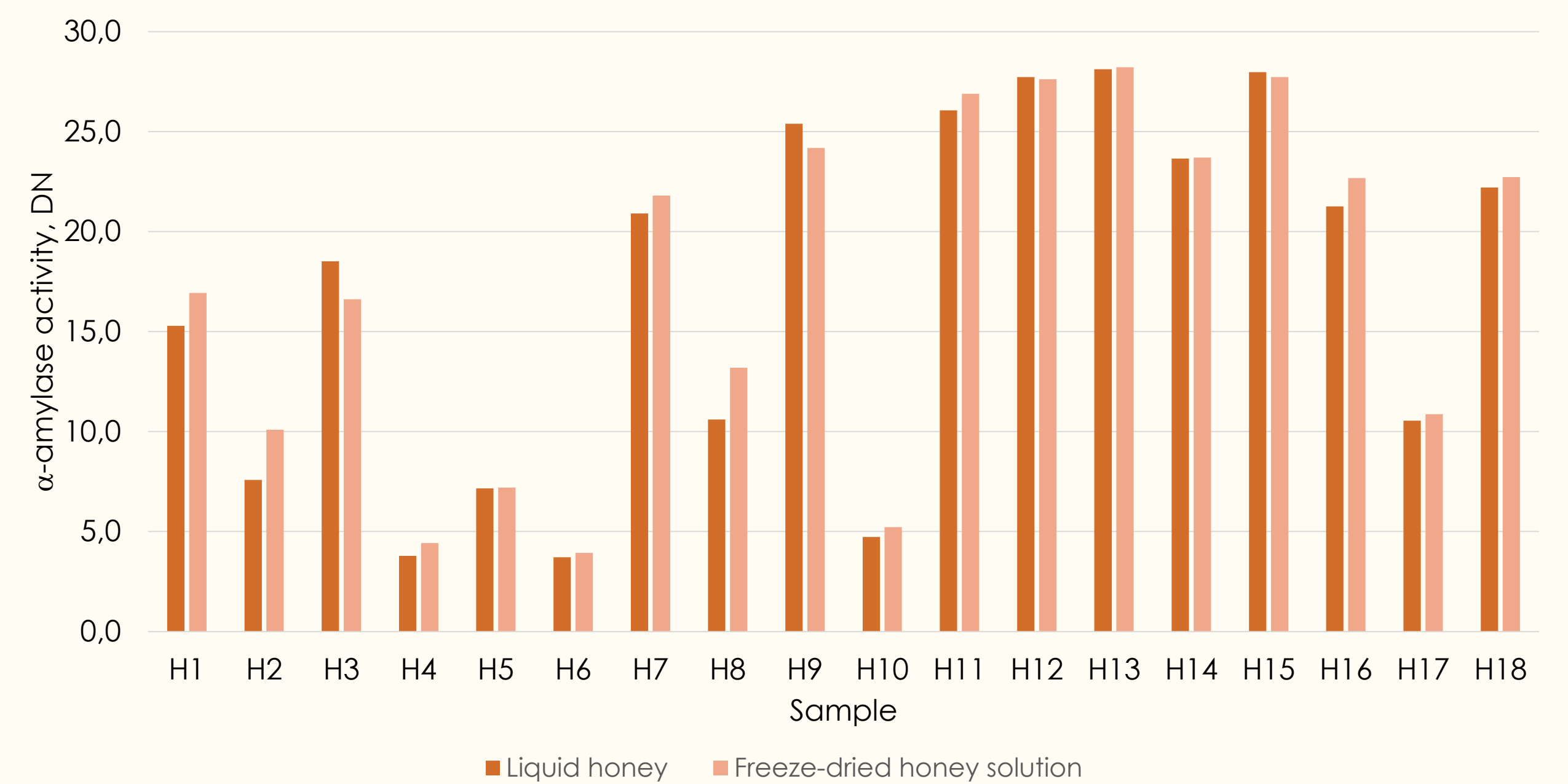


Figure 4 α -amylase activity in liquid honey and freeze-dried honey samples

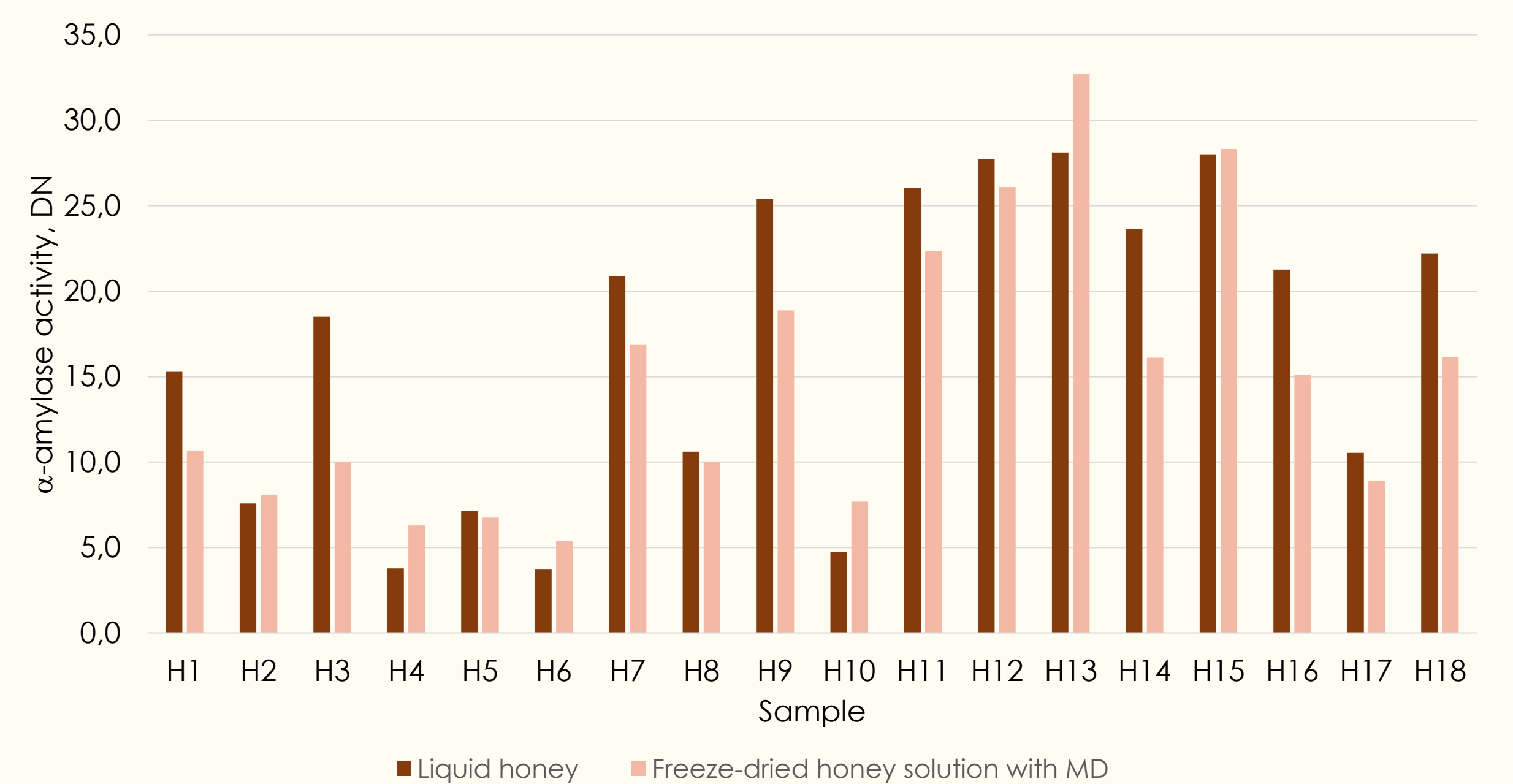


Figure 5 α -amylase activity in liquid honey and freeze-dried honey with maltodextrin (MD) samples

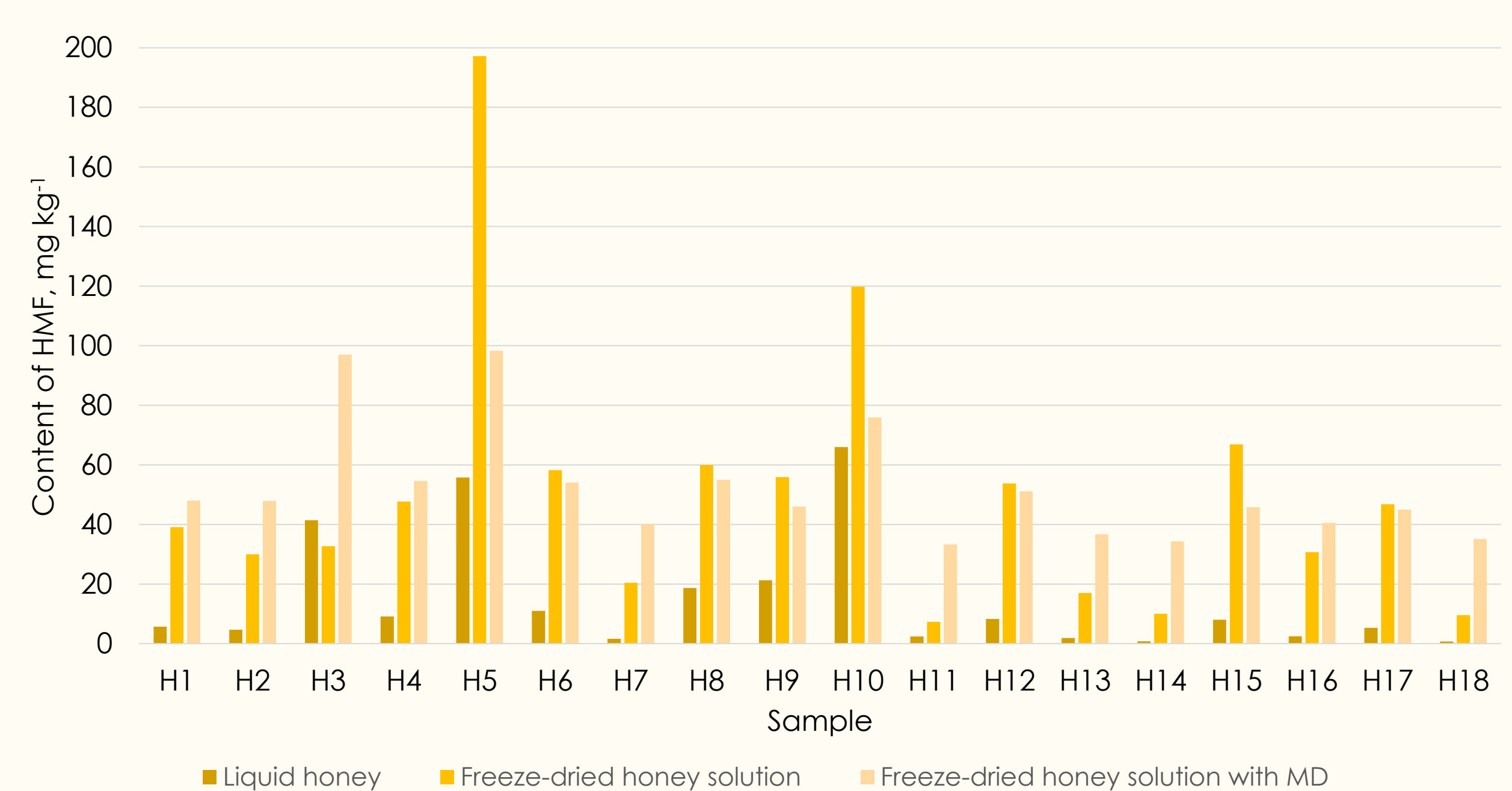


Figure 6 Content of hydroxymethylfurfural in the analysed samples

Conclusions

The present study showed that freeze-drying can be used to obtain dehydrated honey. Honey is a sugar-rich natural product, which contains low molecular weight sugars such as fructose, glucose and sucrose. The high concentration of these sugars makes it impossible to freeze-dry honey without adding carriers or drying aids such as maltodextrin. In this study, the freeze-dried honey samples, which were prepared without adding maltodextrin, rehydrated from the moisture in the atmosphere within a few hours (Fig. 3).

α -amylase activity and the concentration of hydroxymethylfurfural (HMF) were determined to detect the quality of obtained freeze-dried honey samples. The obtained results were variable and did not clarify the impact of freeze-drying to the enzyme activity (Fig. 4, 5). The results showed that this enzyme was less suitable and less sensitive to detect the quality of honey during the thermal processing at low temperatures. The observed results showed that concentration of hydroxymethylfurfural in most of the analysed samples after freeze-drying was higher than initial concentration of HMF (Fig. 6).

Further studies are needed to examine freeze-drying technique as another alternative method of obtaining high quality honey-rich powders. The optimisation of freeze-drying would allow to produce high-quality honey-rich powder, that could increase the usage of honey in food industry.

Acknowledgments

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