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PP-249 [Beekeeping Technology and Quality]

CHARACTERIZATION OF BOLIVIAN HONEYS FROM HONEYBEES AND STINGLESS BEES

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INTRODUCTION

Bolivia is renowned for its remarkable diversity of bee species hich play a significant role in honey production. *Apis mellifera*, the Western honeybee, is the most widespread species, producing honeys that are extensively studied and regulated worldwide. These honeys typically show consistent nutritional profiles and meet well-established quality standards.
In contrast, stingless bees (Meliponini), which inhabit tropical and subtropical regions, produce smaller volumes of honey with distinctive characteristics, including higher moisture content, greater acidity, and unique bioactive compounds. Despite their cultural and ecological importance, Meliponini honeys have received limited scientific attention, and their composition is still not fully documented. Whitin the SANAPI project, we analysed honey samples collected by beekepers of rural communities across the country in order to provide valuable data on their nutritional and microbiological properties, improve their valorization, and contribute to the conservation of traditional beekeeping practices in Bolivia.

MICROBIOLOGICAL ANALYSIS

Due to the absence of specific European or international regulations regarding the microbiological parameters of honey, the *Guidelines for Risk Analysis in the Field of Food Microbiology* issued by the Piedmont Region, Italy (CeIRSA, 2013) were adopted. For yeasts and molds that are not listed in the guidelines, the same threshold values applied to sulfite-reducing anaerobes were considered (Table 1).

Therefore, to verify the hygiene of product processing, samples received by our laboratories were subjected to the following tests: aerobic mesophilic count, sulfite reducing anaerobes, yeast and molds.

Table 1 : Reccomended guidelines for microbiological analyses

Microorganism	Method	Reccomended guidlines (CFU/g)		
		Satisfactory	Acceptable	Unacceptable
Aerobic mesophilic microorganisms	ISO4833	$<10^2$	$10^2 \le x < 10^3$	$\ge 10^3$
Sulfite-reducing anaerobes	ISO15213	<10	$10 \le x < 10^2$	$\ge 10^2$
Yeast and molds	ISO21527-2	<10	$10 \le x < 10^2$	$\ge 10^2$

NUTRITIONAL ANALYSIS

Sugars, total aminoacids, proline, 5-(hydroxymethyl)furfural (5-HMF) were analysed by UHPLC-HR-MS. Minerals were analysed by ICP-MS, while total polyphenols (TP) by Folin-Ciocalteu method.

In Table 2 are reported the results on sugars content. Overall, *Apis mellifera* honey contained higher amount of fructose and glucose (above 64%) compared to Meliponini honey which content was often below the quality criteria (at least 60%) reported in the Directive 2001/110/EC.

Table 2 : Sugar content of different honey types

Honey type	BRIX %	Fructose + Glucose %	Sucrose %	Total Sugars %
Apis mellifera	80.8 ± 2.3	64.0 ± 6.6	0.33 ± 0.17	68.9 ± 6.8
Meliponini	74.6 ± 1.2	60.5 ± 5.0	0.31 ± 0.09	66.4 ± 5.55
	p < 0.001	**p = 0.037**	p = 0.614	p = 0.161

Data are reported as mean ± standard deviation
P< 0.05 significantly different betweent honey type

NUTRITIONAL ANALYSIS

In table 3 are reported the content of aminoacids and minerals of honeys. Compared to Meliponini, *Apis mellifera* honey showed a higher content of aminoacids (mainly proline) and minerals. The main differences were related to the content of potassium, magnesium and zinc.

Table 3 : Content of aminoacids and minerals in the different honey types

Variables	*Apis mellifera*	Meliponini	P values
Total Aminoacids (mg/kg)	1653 ± 823	1102 ± 332	**p = 0.012**
Proline (mg/kg)	1156 ± 470	827 ± 274	**p = 0.003**
Total Mineral (%)	0.13 ± 0.09	0.06 ± 0.03	**p = 0.001**
Potassium (mg/Kg)	56.5 ± 46.1	28.9 ± 20.1	**p = 0.009**
Magnesium (mg/Kg)	4.7 ± 0.6	4.3 ± 0.4	**p = 0.006**
Zinc (mg/Kg)	1.10 ± 0.81	0.39 ± 0.25	**p < 0.0001**

Data are reported as mean ± standard deviation
P< 0.05 significantly different betweent honey type

NUTRITIONAL ANALYSIS

No difference was observed for the levels of 5-HMF that resulted below the legal limits (< 40 mg/kg; Directive 2001/110/EC and 2024/1438) (Table 4).

Table 4 : Content of 5-HMF and related range in the different honey types

	Apis mellifera	Meliponini	P value
5-HMF (mg/100g)	7.05 ± 11.1	2.42 ± 3.8	p = 0.089
Range 5-HMF (mg/100g)	0-43.7	0-11.5	-

Data are reported as mean ± standard deviation

No significant difference was reported in the total polyphenol (TP) content between bee species (Table 5) while a wide variability was documented (range 50-2200 mg/kg).

Table 5 : Content of total polyphenols and related range in the different honey types

	Apis mellifera	Meliponini	P value
TP (mg/100g)	464 ± 461	473 ± 192	p = 0.928
Range TP (mg/100g)	50-2200	70-900	-

Data are reported as mean ± standard deviation

RESULTS & DISCUSSION

Honey is considered a microbiologically stable food. This stability is primarily due to its high sugar concentration and therefore the low availability of free water for microbial growth. However, the environment (soil, flowers, air, honeycombs, etc.) and humans can lead to contamination, especially from yeasts and spore-forming bacteria.

Among the 26 *Apis mellifera* and 31 Meliponini honeys, only one sample (from *Scaptotrigona)*, revealed values above the acceptability level for the European marketing of this product.

Regarding the nutritional composition, *Apis mellifera* honey contained higher amount of fructose and glucose as well as aminoacids (mainly proline), and minerals (potassium, magnesium and zinc), while no significant difference was observed for the levels of 5-HMF and total polyphenols. This latter showed a wide variability in line with the data of the literature.

CONCLUSIONS

The preliminary findings documented several differences in the nutritional content between bee honeys. The completion of the analysis will be fundamental for acquiring data useful for a better characterization of the different Bolivian honeys and towards the creation of a honey library.

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Bolivia (South America) hosts a rich variety of bee species that contribute to honey production. While Apis mellifera honey is well-documented worldwide, the honey produced by stingless bees (Meliponini) remains relatively understudied. Given the increasing interest in the characterization of honeys from diverse botanical and ecological origins, studying the properties of both A. mellifera and stingless bee honey provides valuable insights into their quality, authenticity, and potential health benefits. Whitin the SANAPI project, designed to strengthen environmental management initiatives and safeguard production systems that promote forest protection in some Bolivian areas, we analysed honey samples collected by beekepers of rural communities across the country. The microbiological and nutritional quality of honey from stingless bees and honeybees were compared. The analysis of sugars, total aminoacids, proline, 5-(hydroxymethyl) furfural (5-HMF) was carried out by UHPLC-HR-MS. Minerals were analysed by ICP-MS, while total polyphenols (TP) by Folin-Ciocalteu method. Microbiological analyses for total microbial count, yeast and molds and sulphite reducing anaerobes were conducted according to ISO standards and Regional guidelines. The results refer to 23 honey samples from Meliponini bees and honeybees. Only for one sample from Scaptotrigona, the measured values were above the acceptability level for the European marketing of this product. Apis mellifera honey contained higher amount of fructose and glucose (above 64%) compared to stingless bee honey which content was below the quality criteria (at least 60%) reported in the Directive 2001/110/EC. Apis mellifera honey contained also more aminoacids (mainly proline), and minerals (potassium, magnesium and zinc). No difference was observed for the levels of 5-HMF that resulted below the legal limits (< 40 mg/kg; Directive 2001/110/EC). Finally, a wide variability in the TP content (range 50-2200 mg/kg) was documented within and between bee species, in line with the data of the literature. In conclusion, the preliminary findings have highlighted several differences in the nutritional content between bee honeys. The completion of the analysis will be fundamental for acquiring data useful for a better characterization of the different Bolivian honeys and towards the creation of a honey library.