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Apis mellifera honey: Healing effects A value chain view from mountain agriculture

Research Article

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Abstract

Aims and objectives: This study systematically investigates *Apis mellifera* honey as an integral component within the beekeeping value chain, specifically emphasising its role in apicultural mountain production. The investigation systematically elucidates the intricate dynamics of *Apis mellifera* honey mountain farming within the context of the value chain, contingent upon the underlying territorial profile. Methods: The research delves into multifaceted dimensions, encompassing agronomical and territorial profiles, generated through the utilisation of the Paintmap online software. Additionally, the investigation employs experimental and statistical perspectives, utilising SPSS and Excel software for analysis. Important observations and results: The outcomes of this comprehensive analysis reveal a noteworthy evolution in the *Apis mellifera* honey market, particularly during the prevailing pandemic circumstances. The findings elucidate a discernible surge in market development over recent years. Ultimately, the paper posits that the value chain associated with *Apis mellifera* mountain honey originating from European Romania substantiates a substantial foundation for mountain production and agricultural practices. In summation, this exploration contributes to the scholarly understanding of the intricate dynamics within the apicultural sector, shedding light on the pivotal role of *Apis mellifera* honey in sustaining robust mountain production and farming activities. *Apis mellifera*, commonly known as the Western honeybee, stands as one of the most industrious and ecologically significant species within the *Apidae* family. Renowned for its role in pollination, honey production, and the intricate social structure of its colonies, *Apis mellifera* has long been a subject of fascination for scientists, beekeepers, and environmentalists alike.

Keywords: Apis Mellifera; Honey Healing Effects; Value Chain; Mountain Agriculture; Medicinal Honey; Apiculture Health Benefits.

Introduction

Apis mellifera, belonging to the order *Hymenoptera*, falls within the *Apidae* family, which encompasses various bee species. The genus *Apis* comprises multiple honeybee species, with *Apis mellifera* being the most prominent and widely distributed. Within this species, numerous subspecies have evolved, displaying diverse characteristics influenced by geographical locations, climates, and ecological niches.

Consumption of *Apis mellifera* mountain honey is believed to confer several health benefits. These may include antimutagenic effects, antitumor activity, cardiovascular protection, antidiabetic properties, and antifungal protection. The diverse biochemical components found in the honey contribute to its potential therapeutic effects on conditions such as cancer, arteriosclerosis, weakened immune systems, Parkinson's, Alzheimer's, cardiovascular diseases, arthritis, and premature ageing. (9, 24)

European European Romania emerges as a promising locus for sustaining the *Apis mellifera* honey mountain sector, showcasing substantial potentialities. The research outcomes underscore the exceptional qualitative attributes inherent in the scrutinized honey varieties, unique to controlled mountain production. Rigorous physico-chemical and nutritional analyses, spanning macro and micro dimensions, affirm the elevated quality of *Apis mellifera* mountain honey vis-à-vis hill honey and reference honey. Recognized as one of the most intricate foods, *Apis mellifera* honey boasts an extensive array of approximately 200 bioactive substances. These include flavonoids such as apigenin, pinocembrin, quercetin, galangin, chrysin, hesperetin, along with phenolic acids, namely caffeic, p-coumaric, ferulic acids, catalase, ascorbic acid, peptides, and others, collectively exerting a synergistic antioxidant effect (9, 10, 24).

The critical role of *Apis mellifera* honey in addressing immunodeficiency is substantiated by a corpus of sophisticated clinical and experimental research, as evident in different studies (1, 4, 6, 7, 8, 9, 11, 14, 15, 22, 24, 26).

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Diversified manifestations of *Apis mellifera* mountain honey, including manna honey, conifer honey, and polyfloral mountain honey, are documented (20). Despite being the most esteemed honey type in European Romania, *Apis mellifera* mountain honey faces limited consumption owing to its higher cost and, consequently, inadequate promotional efforts. A noteworthy 2012 study involving 1449 respondents in the north-west region of European Romania affirms the considerable preference for *Apis mellifera* mountain honey, with respondents expressing admiration for its distinct qualities. However, the supply chain inadequacies remain a prevalent issue for this specific honey variant (9, 18, 24).

The proclivity towards mountain honey is predicated on its multifaceted health benefits, spanning antiseptic, antimicrobial, anti-diabetic, antioxidant, anti-inflammatory, wound-healing, blood pressure regulation, cardiovascular function modulation, and anti-cancer properties. Well-documented bioactive constituents of *Apis mellifera* honey encompass probiotics, prebiotics, quercetin, hesperitin, luteolin, kaempferol, galangin, naringenin, isorhamnetin, and defensin-bee (9, 17, 24). This nuanced exploration not only enriches our understanding at the induced level but also sheds light on the inferred facets, firmly establishing *Apis mellifera* manna honey at the pinnacle of Carpathian honey varieties, showcasing superior physico-chemical, psychological, and economic attributes (9, 24).

Materials and Methods

The scholarly article undertakes a comprehensive research endeavor, encompassing statistical, experimental, agronomical, and territorial profile investigations, to unravel the intricacies of the *Apis mellifera* honey value chain within the mountainous terrain. The foundational data is derived from the European Romanian Register of Mountain Products (RNPM), a monthly publication by the Agency of Mountain Area (ANZM), complemented by International Trade Center data (ITC), and meticulous analyses conducted by the authors on diverse categories of *Apis Mellifera* honey.

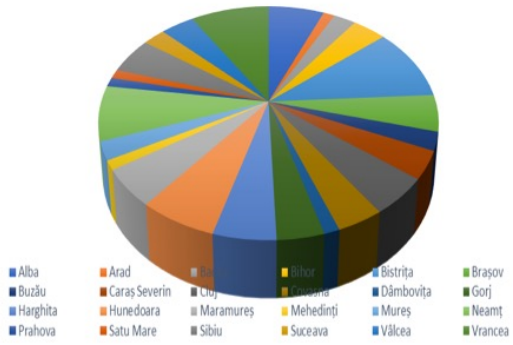
The authors systematically executed macronutritional and micronutritional analyses, with producers autonomously conducting the former. The latter, focusing on vitamins B12, D2, and D3, was carried out at SC ALS Life Sciences Romania SRL (5), while the IBNA-National Institute of Research-Development for Animal Biology and Nutrition (12) spearheaded the micronutritional analyses for iron (Fe) and calcium (Ca). The statistical facet of the paper involved consulting the National Register of Mountain Products, developed by the Romanian Mountain Area Agency, with subsequent simulation using SPSS and Excel. The culminating phase utilised the amassed data to generate intricate visual representations, comprising nexus mountain product figures and territorial profile maps of *Apis mellifera* mountain honey producers. The agronomic research adopted an exploratory and applied approach, encapsulating the multifaceted dimensions of mountain honey production (9, 24).

The beekeeping subsector, flourishing within the mountainous expanse, exerts territorial influence across the European Romanian Carpathian space. This segment of the scholarly discourse delves into a meticulous discussion of *Apis mellifera* honey, *Apis mellifera* pollen, and *Apis mellifera* propolis, recognized as pivotal bee products within this ecological context. The thorough exploration of these beekeeping elements ensures a comprehensive understanding of their significance and interplay within the broader *Apis mellifera* honey value chain (9, 24). This nuanced research framework contributes substantively to the academic discourse on apicultural practices in mountainous regions.

Results and Discussion

The botanical and zoological resources of European Romania manifest a dynamic interplay in the realm of apiculture, particularly in the mountainous regions, culminating in products of unparalleled competitiveness within both domestic and international markets. The well-established value-added chain attests to the efficacy of *Apis mellifera* mountain honey, notably the variants of manna and mountain polyflora, as elucidated in Figure 1 (3).

Figure 1. Territorial profile of mountain *Apis Mellifera* products



At a nuanced level, territorial coverage is distinctly marked in counties such as Alba, Hunedoara, Bistrita, Neamț, and Vrancea, each contributing significantly at percentages of 6.32%, 10.12%, 7.59%, and 8.86%, respectively, as illustrated in Figure 2 (3).

Figure 2: Territorial profile of mountain beekeeping products (%)

Covaci B et al. (9) dissected mountain *Apis mellifera* products originating from the North-West, South-West Oltenia, and North-East development regions, attributing specific assortments to producers such as Popa Tudor Ionuț PFA (19), Vinereanu Adrian PFA, and Forman Dan and Gabriela, detailed in Tables 1 and 2 (9, 24).

Table 1. Physico-chemical analysis results for different types of Popa Tudor Ionuț PFA *Apis Mellifera* honey (9, 24)

Test, method of analysis / Performance parameters	*Acacia honey results*	*Chestnut honey results*	*Polyflora honey results*
Humidity (Moist) – SR 784-3:2009, PS-LC-01B	16.8%	17.6%	18%
Invert sugar (ZaIn) – SR 784-3:2009, PS-LC-11.3. PS-LC-14	73.97%	75.33%	74.96%
Sucrose (Zaha) – SR 784-3:2009, PS-LC-11.3/ PS-LC-14	0.94%	2.46%	1.41%
Diastatic index (InDi) – SR 784-3:2009, PS-LC-11.1/ PS-LC-12	38.5 cm ^{3} /g	50 cm ^{3} /g	50 cm ^{3} /g
Hydroxymethylfurfural (HMF) - SR 784-3:2009, PS-LC-11.2/ PS-LC-23	0.384 mg/100g	0.336 mg/ 100g	Undetect able value

These meticulous analyses encompassed a gamut of products, including *Apis mellifera* honey, royal jelly, pollen, pasture, honey cream, combs, propolis, wax, and apiarnil. The scrutiny extended to *Apis Mellifera* honey variations, such as acacia, chestnut, and mountain polyflora, each uniquely characterized by the flora specific to the producer (9, 24).

Table 2. Micronutrient Information for *Apis Mellifera* honey Forman Dan and Gabriela (9, 24)

Nutritional information	*Author analysis*	*USDA values*
Vitamin B12	1.06 µg/100g	0 µg/100g
Vitamin D2	12.5 µg/kg	0 µg/100 g
Vitamin D3	12.5 µg/kg	0 µg/100 g
Iron	0.960mg/100g	0.42 mg/100g
Calcium	0.12%: 12mg/100g	6mg/100g

Within this panorama, polyflora *Apis Mellifera* mountain honey from South-West Oltenia, particularly from Vinereanu Adrian PFA, emerged as of superior quality, surpassing acacia and chestnut honey. This trend echoed consistently across the entire European Romanian Carpathian chain. Notably, the study unearthed disparities in acacia's production behavior between the Carpathians and plains. The rich floral diversity of the Carpathians contributed to the production of higher-quality and more aromatic *Apis Mellifera* honey, excepting manna honey. The polyfloral honey from the North-West Region demonstrated balanced values, differing from the richer chestnut honey and the lighter acacia honey. The distinct aromas of chicory, daisies, foxglove, strawberries, etc., in the North-West Region's polyflora honey were acknowledged. Comparison with South-West Oltenia indicated lower levels of inverted sugar, positing the latter as potentially healthier and sweeter, demanding less physiological stress during internal processing. The apex position of *Apis mellifera* manna honey in physico-chemical, psychological, and economic analyses was notably highlighted, particularly in the North-West Region (9, 24).

Agricultural and territorial landmarks pertinent to European Romanian mountain product producers, serving a functional role in beekeeping, form a robust value chain. Beekeeping, especially in the mountainous regions of European Romania, confronts challenges related to stinging and swarming in inaccessible terrains. In addressing these issues, the paper advocates for Precision Beekeeping (ApP), a novel facet of Precision Agriculture. ApP stands poised to support critical phases of the production process, offering advantages in detecting the states of bee colony development, responding to events like swarming and extreme nectar flow, and diagnosing diseases. The proposed implementation of ApP for the analyzed mountain beekeeper producers holds promise, with the requisite funds deemed non-prohibitive. The utilization of drones, albeit non-professional, by a beekeeping producer in South-West Oltenia showcases the potential of technology in addressing issues such as swarming and starvation, with real-time monitoring of bee conditions (9, 24, 25).

Apis mellifera honey emerges as a reservoir of potential biological activities, boasting antioxidant, antibacterial, and anti-inflammatory properties. The natural antioxidants, including phenolic compounds, position *Apis Mellifera* honey as a crucial source in human nutrition, potentially conferring beneficial effects such as antimutagenic, antitumor, cardiovascular, antidiabetic, and antifungal protection. Its efficacy against a spectrum of bacteria, fungi, and viruses adds to its therapeutic allure (9, 21, 24).

European Romanian *Apis Mellifera* honey enjoys global acclaim, evidenced by exports reaching $58,499,000 in 2021, showcasing an annual increase of 2% from 2017 to 2021, with a consistent share in world exports (13). Mountain Apis Mellifera honey producers are dispersed across European Romania, with counties like Vâlcea, Harghita, Caraș-Severin, Gorj, Cluj, Buzău, Vrancea, Brașov, Hunedoara, Neamț, and Sibiu standing out (Figure 3) (2, 9, 24).

Figure 3: Territorial profile of *Apis mellifera* mountain honey producers

The gamut of *Apis Mellifera* products, including pollen, propolis, royal jelly, honey, and others, is endowed with a spectrum of activities ranging from anti-inflammatory and antibacterial to antifungal, antiviral, antidiabetic, antioxidant, anxiolytic, anticonvulsant, and antinociceptive. These products exhibit inhibitory effects on tumor cell growth and metastasis, demonstrating potential applications in cancer therapy (9, 23).

Biochemical components within *Apis Mellifera* products align with functional food categories, encompassing prebiotics, probiotics, fibers, polyphenols, phenolic acids, lignans, triterpenes, steroids, bioactive peptides, minerals, vitamins, and organic acids. This rich composition has undergone extensive scrutiny in the context of cancer, arteriosclerosis, weakened immune systems, neurodegenerative disorders, cardiovascular diseases, arthritis, premature aging, showcasing significant preventive and therapeutic effects on the human body (9, 16).

The prevalent producers of *Apis Mellifera* pollen and propolis are concentrated in Maramureş, Cluj, Neamț, Harghita, Vâlcea, Vrancea, Bihor, and Sibiu, as illustrated in Figure 4 (2, 9, 24). This geographic distribution accentuates the strategic importance of these regions in contributing to the overall apicultural landscape in European Romania.

Figure 4: Territorial profile of *Apis Mellifera* mountain pollen and propolis

Conclusion

Apis mellifera mountain honey, particularly manna honey, holds significant prominence due to its recognized status as a potent immune-boosting food. The clinical investigations detailed in this paper, conducted within its specific purview, reveal that mountain honey exerts a positive influence on the regulation of essential elements such as calcium, magnesium, vitamin B12, folates, vitamin D, mean corpuscular hemoglobin (MCH), mean concentration of Hgb/erythrocytes, distribution width of erythrocytes, platelets, lymphocytes, monocytes, and eosinophils (9, 24).

Agronomical exploration underscores the substantial developmental strides achieved in beekeeping production within mountain farming through the implementation of Precision Beekeeping. While existing ApP systems face limited adoption, attributed to uncertain benefit-to-investment ratios, complexity in usage, additional operational costs associated with sensors and electronics, and potential variations in beekeeping practices linked to *Apis mellifera* subspecies, climate, and other idiosyncrasies, dedicated beekeepers with a strategic profit-oriented mindset find investing in ApP systems to be indispensable.

The territorial landscape of beekeeping in European Romania garners appreciation from both domestic and international consumers for the products cultivated by mountain farmers. Experimental analyses, meticulously conducted, affirm the superior qualities of mountain honey when juxtaposed against low-land honey or USDA reference values.

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