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BIOCHEMICAL AND ECONOMIC DIMENSIONS OF APILARNIL WITH A FOCUS ON ROMANIAN APICULTURE

Antoaneta Roxana SPULBER[1], Teodora COLȚA[1], Cosmina SMEDESCU[2], Cristina VĂDUVA[1], Maria DINCĂ[1], Silviu Ionuț BEIA[2], Dragoș SMEDESCU[2]

[1]Institute for Beekeeping Research and Development, IARD, 42 Ficusului Blvd., District 1, 011464, Bucharest, Romania, Phone: 021/2325060; E-mails: roxana.spulber@icdapicultura.ro, teodora.colta@icdapicultura.ro, cristina.vaduva@icdapicultura.ro, maria.dinca@icdapicultura.ro
[2]University of Agricultural Sciences and Veterinary Medicine of Bucharest, 59 Marasti, District 1, 11464, Bucharest, Romania; E-mails: smedescu.cosmina@managusamv.ro, beia.silviu@managusamv.ro, dragos.smedescu@managusamv.ro

Corresponding author: dragos.smedescu@managusamv.ro

Abstract

Apilarnil is a beekeeping product obtained from drone larvae, recognized for its biochemical and therapeutic properties, but also for its economic potential. The present study explores both the biological dimensions and medical uses of apilarnil, as well as its economic and managerial implications in the context of Romanian beekeeping. The analysis includes the presentation of existing products on international markets, highlighting the diversity of pharmaceutical forms and therapeutic applications, from supporting reproductive and immune health to anti-aging and vitality-stimulating effects. In parallel, data on the structure and organization of the beekeeping sector in Romania are evaluated, with a focus on the number of beekeepers and the relevance of financial indicators. The results emphasize that apilarnil has a dual role: on the one hand as a biological resource with multiple health benefits, and on the other hand as an economic opportunity that can contribute to strengthening the competitiveness and sustainability of Romanian beekeeping in a European and international context.

Key words: *bee drone, beekeeping, Apilarnil, apiculture, added-value product*

INTRODUCTION

Apiculture constitutes a specialized sector within agriculture that utilises natural resources through managed bee colonies to produce honey and other apicultural products [21]. Beekeeping provides income and enjoyable outdoor work in both rural and urban areas [22]. Apilarnil is a bee-derived product obtained from homogenized drone larvae (*Apis mellifera*) collected on the seventh day of development, before the sealing of the brood cells [9]. Since its discovery, this product has attracted increasing interest due to its complex biochemical profile, which is comparable in some respects to royal jelly but enriched in specific sterols and hormone-like compounds. For this reason, apilarnil is considered both a functional food and a potential apitherapeutic agent [5].

The general composition of apilarnil includes approximately 65–70% water, 10–15% proteins, 15–20% carbohydrates, 3–6% lipids, and 1–3% vitamins and minerals [36]. This chemical heterogeneity underpins the wide spectrum of biological activities attributed to the product. Modern analyses (LC-MS/MS, GC-MS) have revealed fatty acids, peptides, flavonoids, glycerophospholipids, sugars, steroids, and volatile compounds such as esters and ketones [19]. Proteins are a major fraction, and they include both structural proteins and bioactive peptides. Essential amino acids such as lysine, methionine, and tryptophan are present in significant amounts, contributing to protein synthesis and tissue regeneration [5]. Moreover, antimicrobial peptides, analogous to those found in royal jelly, may support the immune system and exert protective effects against pathogens [36]. The lipid fraction, though smaller, is of special importance. It contains medium-chain and polyunsaturated fatty acids, as well as sterols such as cholesterol and testosterone-like derivatives [9]. These compounds are thought to contribute to the tonic and androgenic properties traditionally attributed to apilarnil. Experimental data suggest that sterols and fatty acids from drone larvae may play a role in modulating endocrine activity and supporting reproductive function, though more controlled human studies are needed to validate these claims [5].

Carbohydrates, mainly glucose and fructose, represent a readily available source of energy. Their proportion is like that found in royal jelly, supporting the role of apilarnil as a stimulant and energy booster [10]. In addition, minor amounts of oligosaccharides may contribute to prebiotic effects, although this hypothesis remains insufficiently explored.

Vitamins and minerals, although quantitatively less abundant, are biologically significant. The B-complex vitamins (thiamine, riboflavin, pyridoxine, pantothenic acid) are particularly well represented and support enzymatic activity and cellular metabolism [36]. Provitamin A carotenoids and vitamin D precursors have also been identified in lower concentrations, suggesting potential antioxidant and regulatory effects. Among minerals, potassium, calcium, magnesium, iron, and zinc dominate the profile, playing crucial roles in enzymatic catalysis, neuromuscular function, and immune defense [10].

Another component of apilarnil is represented by nucleic acids (DNA and RNA) and enzymatic molecules derived from larval homogenates. These compounds may stimulate protein synthesis, cell division, and regenerative processes, although data on their specific bioactivity in humans are still limited [5]. The presence of enzymatic systems such as proteases and oxidoreductases further enriches the biochemical complexity of apilarnil.

Overall, the nutritional and biochemical composition of apilarnil explains the wide range of biological effects attributed to its consumption: anabolic and restorative actions due to amino acids and sterols, immunomodulatory potential from bioactive peptides, rapid energizing capacity from carbohydrates, and antioxidant and metabolic support from vitamins and minerals.

Due to its rich amino acid and micronutrient content, apilarnil is regarded as a promising nutritional supplement. Scientific studies indicate antioxidant and adaptogenic activities [19], while experimental models have shown androgenic and anabolic effects, including improvements in testosterone levels and reproductive parameters [2]. Other reported benefits include immunostimulatory, hepatoprotective, neuroprotective, and fertility-supportive actions [4].

Apilarnil represents an added-value product that allows beekeepers to diversify their income sources beyond honey and wax. This diversification can strengthen rural economies and contribute to local sustainability [32]. For human health, apilarnil's nutrient density makes it a potential natural remedy against micronutrient deficiencies and lifestyle-related diseases [4].

The sustainable production of apilarnil is closely connected to pollinator health. Climate-related stressors such as shifts in flowering times, extreme weather events, and increased pathogen pressure may negatively affect bee colonies, thereby reducing both honey and drone brood availability [38]. Consequently, climate-resilient apicultural practices are essential to preserve this resource and maintain its role in supporting rural economy and human health.

In recent years, global warming has been a cause of climate change, affecting both bee populations and melliferous flora [14]. These changes have negative consequences for nectar and pollen production in flowers, on pollination activity and on bee productivity. Pollination is essential for maintaining biodiversity and ecological balance, and it has a significant economic impact worldwide [29]. Environmental factors such as temperature, humidity and wind strongly affect the physiological processes of plants, as well as the development and behavior of bees. Among these, temperature is the most important, as it shapes both the activities carried out inside the hive and the foraging patterns and physiological responses of bees, having a direct effect on the health of the colony [1, 37]. Research has shown that low temperatures (below 7°C) negatively affect the bees' foraging capacity. Conversely, a positive correlation has been observed between temperature and foraging efficiency, due to lower metabolic rates at higher temperatures [18].

Exposure to extreme temperatures during foraging significantly reduces the lifespan of honeybees. Brood development is highly sensitive to temperature, with both suboptimal low and high thermal conditions associated with increased risk of colony loss. Non-optimal temperatures during brood rearing have been shown to result in neural impairments and morphological abnormalities, particularly affecting wing structure [12].

The reduction in foraging activity has negative consequences on brood development by slowing down larval growth and maturation, as well as on food reserves for overwintering [16]. Food reserves, represented by nectar and pollen, are also influenced by external temperature, crucial for the development and survival of colonies. Prolonged cold periods during spring, when the colony is developing, hinder the bees' foraging activity, leading to a rapid depletion of food reserves in the hive and to colony weakening or even loss. The egg-laying rate, larval feeding with pollen, and the development of new generations of bees depend on changes in climatic conditions, which influence the distribution of plant species, the flowering period and the production of nectar and pollen [14].

Climate change reduces pollen availability, disrupting the honeybee's brood development cycle.

Humidity represents an additional climatic factor that influences not only plant physiology but also the behavior and physiology of honeybees. Within the hive, humidity levels play a critical role in processes such as honey ripening and egg hatching. Optimal relative humidity for successful egg hatching ranges between 90–95%; levels below 50% have been correlated with a significant reduction in hatch rates. To maintain optimal humidity within the hive, bees engage in various adaptive behaviors: to increase humidity, they evaporate water from nectar and actively seek external water sources; to reduce humidity, they ventilate the hive by fanning their wings to expel moist air [1].

Excessive precipitation interferes with foraging activity, thereby limiting access to nutritional resources. Moreover, ambient humidity affects nectar concentration in flowers and, consequently, bee foraging behavior. Bees respond to changes in climate by selecting more diluted nectar during hot and dry periods, or by visiting flowers where nectar has been concentrated due to dry winds.

Prolonged drought causes a decrease in nectar secretion and its quality, which, when combined with a pollen deficit characterized by low nutritional value, results in weakened immunity and incresead vulnerability of bee colonies to diseases and pests [14].

The goal of the research is to analyze the biochemical composition and therapeutic applications of apilarnil, while also evaluating its economic significance and potential for enhancing the competitiveness and sustainability of Romanian apiculture in the context of European and international markets.

MATERIALS AND METHODS

To carry out this research, a documentary and comparative analysis methodology was used, based on scientific sources, specialist reports and statistical data. Information regarding the biochemical composition and therapeutic uses of apilarnil was collected from national and international specialist literature, including articles published in academic databases, manuals and reference works in the field of beekeeping and beekeeping biotechnologies.

Data regarding commercial uses and products available on the international market were obtained by consulting official online sources, beekeeping product catalogues and specialist publications, allowing a comparative analysis between various countries (Romania, Russian Federation, Germany, Turkey, Canada, USA).

For the economic part, statistical data provided by the Romanian Beekeepers Association and other relevant indicators at sectoral level were analyzed. Correlating this information allowed highlighting the role of apilarnil from three perspectives: biochemical, commercial and economic-managerial.

RESULTS AND DISCUSSIONS

At the end of 20th century, Apilarnil yield in Romania was in early stages, given the market potential that was foreseen at the time within the Romanian context. Nevertheless, production progressed rapidly, with seasonal volumes starting at approximately 500 kg in 1981 and reaching up to 16,000 kg by 1984, reflecting both growing interest and the scalability of this novel bee-derived product (Fig.1). Despite many years of limited market uptake, estimates in Denmark suggest a potential yield of up to 80 tonnes per year [15] reflecting renewed interest in its integration across food, health, and feed industries.

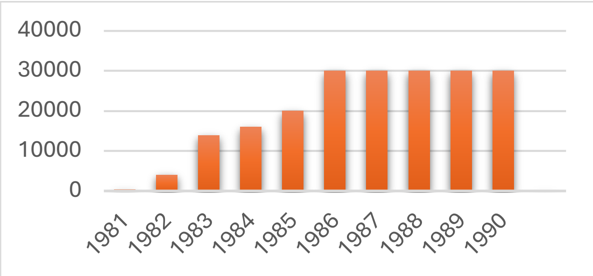

Fig. 1. Raw Apilarnil production in Romania 1981 -1990
Source: [8].

In Romania, Apilarnil production is directly influenced by market demand dynamics and its potential applications as well as by climatic factors with impact on size of colony, availability of food, colony microclimate [29]. In the last years, even the fact that production potential of Apilarnil is very high in Romania, Apilarnil aquired for application in medicinal or cosmetic formulations was very low (Fig. 2).

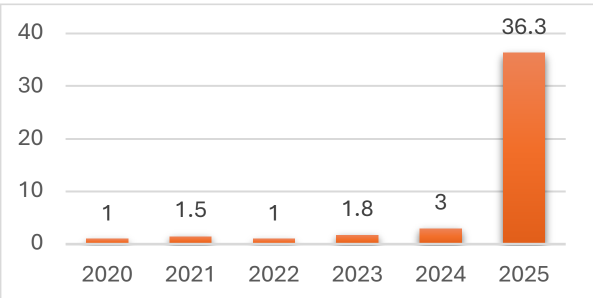

Fig. 2. Processed Apilarnil Quantity in Romania (Kg)
Source: Romanian Bekeepers Association [28].

One of the key factors influencing the development of the beekeeping sector is the diversification of the product range offered by beekeepers to consumers. In this context, identifying new opportunities to add value to hive-derived products, through innovative formulations developed either domestically or abroad, can generate export opportunities for the sector.

This becomes particularly relevant considering that only 33% of Romanian beekeepers are currently interested in foreign markets. Due to the very small quantities being processed or consumed fresh, Apilarnil is not among the bee products exported at present. Instead, export reports show high volumes for honey (93.1%), propolis (59.7%), beeswax (43.9%), and royal jelly (8.8%) [24]. Colony growth is constrained by pollen deficiency or inadequate nutrient intake, particulary as drone larvae require substantially larger quantities of food with a more diverse protein profile than worker bee larvae due to an extended developmental period involving spermatogenesis and organogenesis [31]. In this context, N. Hrassnigg and K. Crailsheim, (2005) estimated that daily pollen consumption is around 325-487,5 mg pollen to produce Apilarnil – more than three times the amount required for rearing worker bee larvae [7]. The European Commission has recently accelerated the integration of edible insects into mainstream European diets, recognizing them as a sustainable and efficient alternative protein source [27]. This process was facilitated primarily by their legal authorization for commercialization on European market through their inclusion in the Novel Foods list under Regulation (EU) 2015/2283 [26]. This development is largely driven by the urgent need to meet growing global food demand amid declining agricultural yields. In this context, drone brood, also known as Apilarnil, stands out as a valuable yet underutilized bee product. While relatively unknown in most of Europe, it has long been appreciated for its nutritional and therapeutic properties in countries such as Romania, China, Zambia, Senegal, and Ecuador [30]. Although bee brood is acknowledged by the local population and consumed in Thailand, where it remains a niche element of the culinary tradition [33] it is typically avoided in the Russian Federation due to cultural perceptions, [24]. In contrast, in country like Austria and Germany, bee brood is gaining popularity as food snacks called ”Biennengramled” or ”bee crackle”, as well as in deserts such as chocolate mousse or ice creams, while in Turkey, Apilarnil, is primarily promoted as a functional food, being used as a meat substitute or as a protein concentrate similar to soy [35] identified in this way new potent source of high-quality protein in the context of global search for sustainable food ingredients [25].

International market analysis shows varied therapeutic uses of apilarnil. In the Russian Federation, the preparations *Bilara* and *Femo-Klim* are associated with maintaining the health of the microcirculatory system and alleviating menopausal symptoms, respectively, being formulated as powders and lyophilized tablets [13]. In Romania, the variety is much more pronounced, with the emergence of products such as *Apilarnil Potent*, intended for the treatment of male sexual dysfunction, *Activated Lyophilized Apilarnil*, used to increase vitality, support circulation, and combat physical and mental fatigue [17], or *Apicioco with Apilarnil*, with nutritional, biostimulatory, and skin-regenerating effects. Furthermore, *Apilarnil Forte* targets general fatigue, low immunity, and metabolic and digestive disorders, while *Apilarnilprop* acts as an energy stimulant and biological activator.

At the international level, the Canadian product *ApiDrohn* is aimed at maintaining hormonal balance and energy levels, while in Turkey, *Arbee Energy Apilarnil* is marketed as a general tonic, available both in powder and capsule form. Germany offers two distinct products: *Apilarnil frisch*, a fresh formulation with energizing effects, and *Apilarnil lyophilisate*, capsules intended for the same functional area. In the United States, *Drone Brood Homogenate* stands out for its broader therapeutic spectrum, including anti-aging, antioxidant, neuroprotective, and muscle-enhancing effects, being available in lyophilized capsule form.

The predominance of lyophilized formulations is primarily intended to preserve the product’s stability, as studies have shown that Apilarnil retains its quality characteristics for up to six months at 20°C when packaged either in glass containers or in hermetically sealed, triple-layer aluminum-based film under a nitrogen atmosphere [24]. Furthermore, the lyophilized form has demonstrated higher consumer acceptability compared to oven-dried alternatives, confirming its preferential use in both food and therapeutic formulations [3]. Other research has also indicated that honey enriched with lyophilized bee brood maintains a more stable formulation than honey supplemented with 4% frozen bee brood, the latter exhibiting visible darkening and consistency changes [31].

In parallel, it is important to note that *Varroa destructor* is widely recognized as the most harmful parasite affecting honeybee colonies [11, 34], with a strong reproductive preference for drone brood, where infestation levels can be up to twelve times higher than in worker brood [20]. As a response, some beekeepers have adopted strategic removal and utilization of drone brood to naturally regulate Varroa populations [30]. Nevertheless, the effective implementation of such biological control strategies requires adequate beekeeper training [6]. Beyond its role in pest management, the selective harvesting of drone brood also generates economic opportunities, both by reducing reliance on chemical treatments and by opening new avenues for marketing drone brood as a value-added hive product.

Overall, the analysis demonstrates that apilarnil represents a biological resource of major interest, with wide applicability across various therapeutic fields, while also offering complementary benefits in apicultural management and economic diversification.

The economic analysis of the Romanian beekeeping sector, with a focus on the production and exploitation of apilarnil, is essential for understanding the real potential of this product. Apilarnil not only offers biochemical and therapeutic benefits but also diversifies beekeepers’ incomes and supports sector growth. Its production and integration on the market depend on factors such as the structure and size of the holdings, the degree of professionalization of beekeepers and the organizational capacity of the entire sector. In this context, the analysis of the number of members of the Romanian Beekeepers Association, corroborated with the available financial data, provides a relevant picture of the size and competitiveness of the industry.

These elements are fundamental for understanding the opportunities and constraints related to the integration of apilarnil on domestic and international markets and allow the identification of strategic directions aimed at strengthening the competitiveness, profitability and long-term sustainability of Romanian beekeeping.

The evolution of the number of beekeepers registered with the Romanian Beekeepers Association (ACA) during the period 2020–2024 highlights a constant downward trend, with a significant decline in recent years. While 12,380 beekeepers were reported in 2020, their number gradually decreased to 11,724 in 2021 and 10,250 in 2022, only to see a slight return to 10,503 members in 2023.

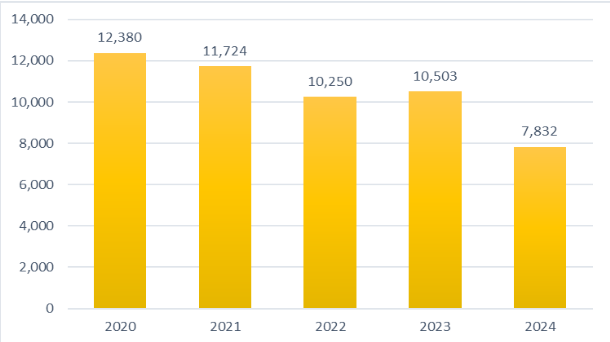

Fig. 3. Beekeeper Numbers in ACA Romania, 2020–2024
Source: Romanian Beekeepers' Association (ACA) [28].

However, the year 2024 marks a steep decline, reaching only 7,832 beekeepers, which represents a decrease of almost 37% compared to the 2020 level.

In the context of the economic analysis of apilarnil, this decrease in the number of beekeepers has direct implications: it reduces production potential and affects Romania's ability to competitively exploit its beekeeping resources, including niche products with added value, such as apilarnil. Therefore, supporting beekeepers and developing market stimulation policies has become essential to ensure long-term sustainability and competitiveness of the sector.

The evolution of the number of bee colonies in Romania, according to data provided by the National Institute of Statistics for the period 2021–2024, highlights moderate annual fluctuations. In 2021, 1,903 thousand colonies were registered, and in 2022 an increase was observed, reaching the maximum level of the analyzed interval, of 1,936 thousand colonies. Subsequently, in 2023, their number decreased to 1,898 thousand, with an increase again in 2024, up to 1,915 thousand colonies.

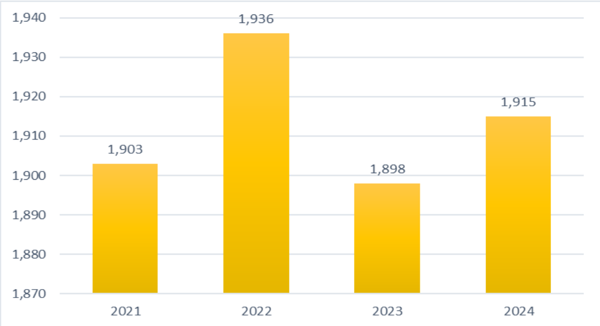

Fig. 4. Bee Colony Numbers in Romania ('000s)
Source: Romanian Beekeepers' Association (ACA) [28].

The amount of honey purchased by the Beekeeping Complex between 2017 and 2020 has registered significant variations, with a generally decreasing trend. If in 2017 approximately 854 tons were collected, and in 2018 the volume decreased to 660 tons, 2019 brought a drastic reduction, reaching only 179 tons. In 2020 the situation improved partially, with 487 tons reported, but the level remains well below that recorded at the beginning of the analyzed period. These fluctuations can be associated both with unfavorable climatic conditions and problems related to the health of bee colonies, as well as with economic difficulties that influenced the production and valorization of honey.

The data analysis shows a significant decrease in the volume of honey purchased in the period 2021–2023, from 533.2 tons to only 218.4 tons, which represents a reduction of over 50%. In 2024, a slight recovery is observed, up to 247.4 tons, but the level remains well below that of 2021. The distribution by counties highlights major disparities: areas such as Vaslui, Hunedoara, Caraș-Severin, Dâmbovița, Mehedinți and Bacău stand out for their high volumes, while many counties have almost zero values. These differences reflect both the particularities of the honey resources and the degree of integration of beekeepers into the collection circuit organized by the ACA. The general decrease can be explained by factors such as unfavorable climatic conditions, economic pressures on beekeepers and the orientation towards other sales channels, which raises questions about the sustainability and competitiveness of the Romanian beekeeping sector.

Table 1. Honey Purchases by Commercial Companies within the Structure of the Romanian Beekeepers' Association (2021–2024)

No.	County	Total honey purchases (t)			
		2021	2022	2023	2024
1	ALBA	0.9	0.0	0.9	0.7
2	ARAD	9.0	0.0	24.0	2.0
3	ARGEȘ	31.0	22.9	0.0	5.0
4	BACĂU	21.0	14.8	70.0	1.0
5	BIHOR	8.3	4.0	0.0	0.0
6	BISTRIȚA N.	1.5	0.0	0.0	0.0
7	BOTOȘANI	12.2	0.0	0.0	0.0
8	BRAȘOV	0.0	0.0	0.0	0.0
9	BRĂILA	0.2	0.0	0.0	0.0
10	BUZĂU	0.0	1.4	1.0	0.0
11	CARAȘ SEV	30.0	93.7	0.0	32.0
12	CĂLĂRAȘI	6.0	3.0	0.0	0.0
13	CLUJ	0.0	0.0	0.4	0.0
14	CONSTANȚA	3.5	0.0	0.0	0.0
15	COVASNA	0.0	0.0	0.0	0.0
16	DAMBOVIȚA	80.0	22.5	0.0	3.0
17	DOLJ	2.8	3.0	1.5	0.0
18	GALAȚI	0.0	0.0	0.0	0.0
19	GORJ	45.0	1.5	2.0	1.0
20	HARGHITA	0.0	0.0	0.0	0.0
21	HUNEDOARA	50.0	30.0	20.0	40.0
22	IALOMIȚA	4.2	p	0.0	0.0
23	IAȘI	0.6	0.0	0.2	0.0
24	MARAMUREȘ	0.0	0.0	0.0	0.0
25	MEHEDINȚI	25.0	28.0	6.0	15.0
26	MUREȘ	11.0	3.0	0.7	0.0
27	NEAMȚ	0.2	0.0	0.0	0.4
28	OLT	0.4	0.2	0.8	0.0
29	PRAHOVA	0.0	0.0	0.0	0.0
30	SATU MARE	0.0	0.0	0.4	0.0
31	SĂLAJ	0.0	0.0	0.0	0.0
32	SIBIU	1.6	0.0	0.5	0.0
33	SUCEAVA	0.2	0.0	0.0	0.3
34	TELEORMAN	3.3	0.6	0.0	0.0
35	TIMIȘ	0.0	0.0	0.0	0.0
36	TULCEA	25.0	7.0	0.0	2.0
37	VASLUI	160.0	42.0	90.0	145.0
38	VALCEA	0.3	0.0	0.0	0.0
39	VRANCEA	0.0	0.0	0.0	0.0
40	BUCUREȘTI	0.0	0.0	0.0	0.0
	TOTAL	**533.2**	**277.6**	**218.4**	**247.4**

Source: Romanian Beekeepers' Association (ACA) [28].

Data on the revenues of commercial companies in the beekeeping sector in the period 2021–2024 reveal an oscillating evolution, marked by decreases and partial recoveries.

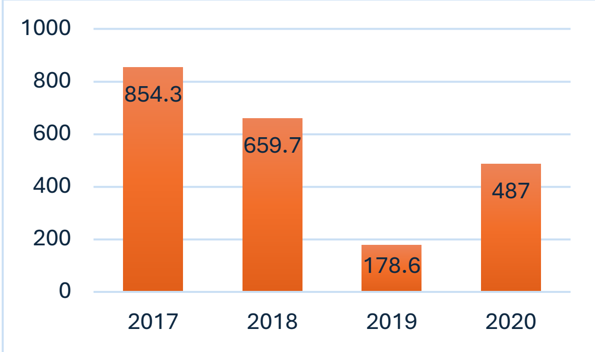

Fig. 5. Quantity of honey purchased by the Beekeeping Complex in the period 2017-2020 (t)
Source: Romanian Beekeepers' Association (ACA) [28].

Table 2. Revenues of Beeking Commercial Companies (2021-2024)

County	**Revenues**				**2024/ 2021 %**
Year	**2021**	**2022**	**2023**	**2024**	
Alba	375,168	484,025	446,293	624,563	166.48
Arad	353,324	349,314	621,266	389,406	110.21
Argeş	1,082,302	1,400,562	1,310,941	1,312,773	121.29
Bacău	1,029,004	943,526	945,577	934,321	90.80
Bihor	2,114,857	2,139,813	2,098,171	2,220,492	104.99
Bistriţa	537,969	777,264	756,581	782,146	145.39
Botoşani	947,385	1,090,577	1,148,126	1,014,234	107.06
Braşov	470,038	744,391	1,101,587	1,390,854	295.90
Brăila	400,147	453,672	474,641	434,668	108.63
Buzău	1,272,030	1,501,712	1,336,040	1,363,263	107.17
Caraş Severin	2,232,690	3,079,136	1,665,949	1,520,794	68.11
Călăraşi	250,328	291,724	250,624	257,298	102.78
Cluj	794,241	836,968	689,236	736,468	92.73
Constanţa	920,342	1,150,266	933,687	681,396	74.04
Covasna	255,113	415,123	505,813	560,824	219.83
Dâmboviţa	2,474,008	2,775,864	2,717,328	2,823,740	114.14
Dolj	1,419,925	1455650	1,336,530	1,296,749	91.33
Galaţi	388,406	540,629	547,069	517,011	133.11
Gorj	1,710,102	2,289,461	1,987,215	2,066,032	120.81
Harghita	488,005	460,798	443,252	431,821	88.49
Hunedoara	4,142,705	3,685,752	2,787,449	2,636,752	63.65
Ialomiţa	605,079	1,236,047	694,557	689,472	113.95
Iaşi	673,740	751,767	789,682	749,704	111.27
Maramureş	1,318,915	1,188,420	1,242,970	1,261,398	95.64
Mehedinţi	1,219,444	1,293,447	1,021,362	1,056,386	86.63
Mureş	1,685,649	2,024,921	1,874,797	1,859,462	110.31
Neamţ	1,021,990	1,195,947	1,184,280	1,261,595	123.44
Olt	623,020	736,144	688,658	734,092	117.83
Prahova	492,542	551,370	538,205	513,485	104.25
Satu Mare	753,115	840,585	886,200	880,450	116.91
Sălaj	1,154,369	1,165,748	1,018,247	1,064,121	92.18
Sibiu	928,516	1,125,426	1,017,368	1,225,070	131.94
Suceava	734,720	916,278	947,562	859,161	116.94
Teleorman	859,309	1,068,352	958,909	913,422	106.30
Timiş	595,652	614,228	531,070	462,539	77.65
Tulcea	366,665	408,192	463,400	499,213	136.15
Vaslui	4,784,878	2,093,033	2,497,537	3,595,769	75.15
Vâlcea	1,927,560	2,184,590	2,042,629	1,798,938	93.33
Vrancea	808,969	937,311	936,340	987,769	122.10
Mun. Bucureşti	570,400	665,352	595,004	617,357	108.23
Total	**44,782,921**	**47,863,385**	**44,032,152**	**45,025,008**	**100.54**
Editura Albina	168,146	121,003	97,005	107,994	64.23
Complex Apicol SA	15,278,116	16,653,446	14,329,316	14,420,867	94.39
ICDA SA	16,174,352	16,303,846	16,105,161	16,989,705	105.04
Total general	**76,403,535**	**80,941,680**	**74,563,634**	**76,543,574**	**100.18**

Source: Romanian Beekeepers' Association (ACA) [28].

At the national level, total revenues increased from 76.4 million lei in 2021 to 80.9 million lei in 2022, only to subsequently register a significant contraction in 2023 (74.5 million lei). The year 2024 brings stabilization, with an income level of 76.5 million lei, which practically represents a return to the reference value of 2021. The analysis by counties indicates considerable variations: significant increases are observed in counties such as Brașov (+195.9%), Covasna (+119.8%), Tulcea (+36.1%) or Sibiu (+31.9%), while sharp decreases are visible in Hunedoara (-36.3%), Caraș-Severin (-31.9%), Vaslui (-24.8%) and Mehedinți (-13.4%). Overall, these developments reflect a sector characterized by regional heterogeneity, influenced both by natural conditions and honey resources, as well as by the organizational and economic capacity of local commercial structures. At the same time, the dynamics of income shows the fragility of the beekeeping market to external factors, along with the existence of internal mechanisms for adjustment and maintenance of functionality.

CONCLUSIONS

The analysis highlights that apilarnil is located at the intersection of the biochemical and economic dimensions, having a dual role: as a biological product with remarkable nutritional and therapeutic properties and as a strategic economic resource for Romanian beekeeping. The study demonstrated that, internationally, apilarnil is recognized through a diversity of pharmaceutical forms and applications, from supporting reproductive and immune health to anti-aging and vitality-stimulating effects. At the same time, the analysis of data from Romania highlights the challenges of the beekeeping sector, reflected in the decrease in the number of beekeepers, fluctuations in the volume of honey purchased and the dynamics of commercial companies' income. These aspects highlight both the vulnerability of the sector to climate change and economic pressures, as well as its potential for adaptation through product diversification and integration into domestic and foreign markets. Strengthening competitiveness and long-term sustainability requires coherent support policies, the professionalization of beekeepers and the strategic valorization of niche products, such as apilarnil, in the context of European and global trends regarding functional foods and alternative protein resources.

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