



Survey on the Situation of the Beekeeping Sector in Two Localities in Northeastern Algeria

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ABSTRACT

Background: Beekeeping is a branch of agriculture practiced by beekeepers. It involves raising bees in order to harvest various products from the hive, such as honey, royal jelly, pollen, wax, propolis, and venom. This study aims to determine the status of this sector in Algeria, specifically in the northeastern region represented by Constantine and Mila.

Methods: The survey was conducted in the Constantine and Mila regions. More than ninety beekeepers were interviewed using thirty direct questions grouped into six topics that covered general profile of the beekeeper, structure and composition of bee yards, beekeeping work, hive products and their marketing, the hive pests, then finally, problems encountered and relationship with the beekeeping world.

Result: The results showed that more than 50% of the interviewed beekeepers are professionals with a practice of more than 15 years. In addition, the melliferous flora presents a remarkable diversity in the two study sites, the products of the hive varies differently between the harvest rate and their financial return. Professional relationships, problems and solutions are discussed and showed a variety observed.

Key words: Bee products, Beekeeping sector, Melliferous plants, Survey.

INTRODUCTION

Beekeeping is a part of agriculture, which consists in the breeding of domestic bees in order to exploit the different products of the hive: honey, pollen, royal jelly, wax, venom and propolis. The major role is not limited to these productions but essentially to the pollination of cultivated entomophilous honey plants. For this, breeders, farmers, agronomists, hunters and technicians practice it.

According to Warré (1948), Beekeeping is the art of cultivating bees in order to obtain the maximum yield from this industry with the minimum of expenses. It is also a very hygienic and beneficial work. Beekeeping differs from one region to another, from one country to another and from one continent to another. This is due to the climate, the flora, the technical and organizational conditions in which beekeeping is practiced.

According to (Frey, 2020), 1,850,868 tons of honey are produced per year in the world.

The People's Republic of China is the largest producer and exporter of honey in the world. In 2018, with 457,203 tons of honey produced, China alone accounted for a quarter of the world's honey production, far ahead of Turkey (6.35% of world production) and Argentina (4.42% of world production).

On the other hand IBO (2021), states that China with Zambia are ranked second in the world of producing countries with 388,067 organic hives, while Brazil ranked first with 898,640. On a global scale, Brazil is the country with the largest number of stingless bee species (Rouzic *et al.*, 2014).

Algeria by its geographical situation and the extent of its territory has very important melliferous potentialities resources, which allow having different honeys; these resources contribute to the appearance of dominant

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beekeeping in multiple following regions: Forests: 4.23 million hectares (including scrub and bush: 1.66 million hectares). Natural meadows with 27 777 ha. In addition, market gardening and fruit plantations with 499,103 ha and 898,930 ha respectively.

From (MADRP, 2016), the beekeeping sector in Algeria has benefited from a considerable financial support within the framework of investment and modernization programs of the Beekeeping Sector, namely: National Plan of Agricultural Development (PNDA) between the years 2000 and 2008. The strategy of the Agricultural and Rural Renewal (RAR) and programs support programs for the sector (PPDRI, PRCHAT, FSAEPEA) between 2008 and 2014. They have allowed having more than 1.3 million hives with the creation of 8,000 breeding units and the donation of 79,000 colonies of bees. As well as the diversification of beekeeping products.

Algeria is ranked forty-third in the world and eighth in Africa with 7324 tons of honey produced. With nearly 40,000 beekeepers whom practice beekeeping at different levels and two species of bees with good genetic potential: the Tellian bee (*Apis mellifera intermissa*) and the Saharan bee (*Apis mellifera sahariensis*).

Each region in Algeria has its own characteristics: climate, vegetation, beekeeping culture and modern and traditional methods used. In other side, beekeepers do their utmost to maximize production by training themselves to solve bee problems, using a variety of methods.

The region of Constantine is a modern city with modern visions. It is the capital of eastern Algeria, well known for its history, civilization and honey production. In contrast, Mila is a rural area where the culture of the citizens is different from that of Constantine, with a very remarkable beekeeping practice.

These two regions share several parameters: Geographical borders, one next to the other, bioclimatic zone, nature of the vegetation cover and beekeeping practices.

To date, we do not have statistics on beekeeping in these regions, except for some standard data that remains incomplete.

The objective of this study is to gain a better understanding of the profile of beekeepers, to quantify the products collected from the hive, to highlight the efforts made in response to the problems encountered. Above all, to conduct a survey of the beekeeping situation in these two regions of eastern Algeria through a series of hierarchically structured questions in order to establish an exhaustive synthesis as possible on this sector.

MATERIALS AND METHODS

Study sites

We carried out this study in two regions of northeast Algeria: The region of Constantine and the region of Mila (Fig 1).

Constantine is located at 430 km from Algiers. It is the main metropolis of Eastern Algeria; it spreads over a very rugged topography at 690 meters altitude on an area of 2288 km², it is bounded by Skikda to the north, Oum el Bouaghi to the south, Guelma to the east and Mila to the west. It has a Mediterranean climate and offers a variety of landforms: mountains, inland basins and high plains. Constantine has preserved the historical vestiges of three millennia of Numidian, Roman, Muslim, Ottoman and French colonial occupation. Known as "the city of suspension bridges", Constantine is perched on a rock and surrounded by impressive gorges. A spectacular destination steeped in history.

Culinary traditions have been preserved and specialties include sweets such as djouzia, a traditional sweet made from bee honey and walnuts.

Mila is known by the largest water dam in Algeria, the Beni Haroun dam that supplies a large part of the eastern region with drinking water and irrigation water, this is what makes its climate humid. Jijel and Skikda bound it to the north, Constantine to the east, Batna and Oum-El-Bouaghi to the south and Sétif to the west. From 460 meters of altitude, it includes mountains, hills, highlands and fertile plains. Mila was an important city in ancient times and was called Milev, a Latin name meaning fountain or water source, due to the considerable water potential it enjoyed. It is also known as the "Queen of cereals and milk". As an agricultural zone, it offers farmers, breeders and beekeepers fertile land for their activities.

The choice of these two regions is taken according to the geographic location of the two regions near each other, which makes the travel, availability and survey process smoother. In addition, the nature of the vegetation cover, which contains a very diverse melliferous flora, is considered. Beekeeping is also taken into consideration.

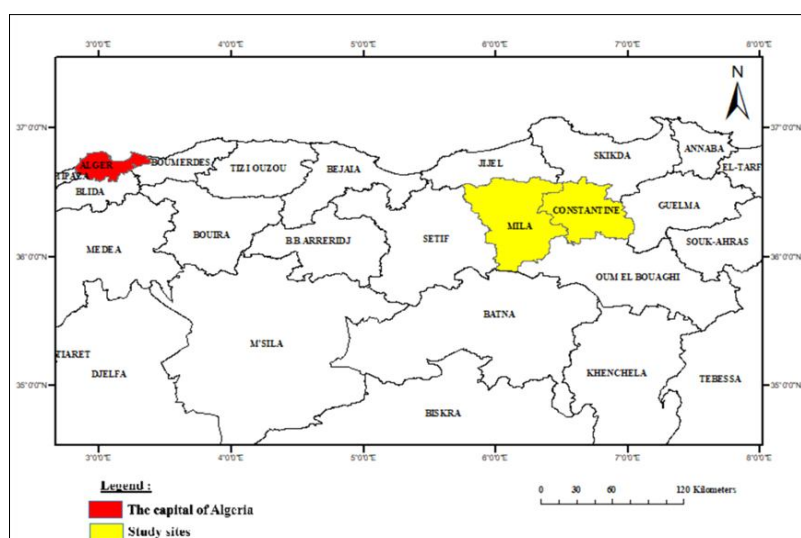


Fig 1: Geographical location of the study sites (Original map, 2023).

Survey description and method

In Algeria, the professional license degree program in beekeeping responsible for beekeeping production is taught exclusively at the University of Constantine 1: the Mentouri brothers.

The university-affiliated research laboratory for bio-systematics and arthropod ecology is responsible for research related to this program. Moreover, as part of it, we conducted this study during the last quarter of 2022: October, November and December. This coincides with the period of preparing the hives for wintering.

The work accomplished is represented through a survey using thirty questions on several aspects of Algerian beekeeping practices. We interviewed five to eight beekeepers per week, questions are asked orally and the appropriate answers are checked and recorded. Beekeepers breed Tellian bees (*Apis mellifera intermissa*) in the two regions.

In this survey, six related topics were covered: General profile of the beekeeper, structure and composition of bee yards, beekeeping work, hive products and their marketing, the hive pests, then finally, problems encountered and relationship with the beekeeping world.

RESULTS AND DISCUSSION

During three months of surveys in the two study regions, 97 beekeepers were interviewed. The detailed results of the various responses are presented as follows.

General profile of the beekeeper

More than 96% of beekeepers surveyed are men, but according to 28,78 % of all of them, woman intervenes in the beekeeping practices: it's a family job. The most practicing are interested in the beekeeping world with 46,39% and those who seek the commercial side with 21,65%. Too few of them (08,25%) had an academic background in beekeeping, while the majority (47,42%) have learned the hive practices from their families, friends or other colleagues. In addition, the role of associations and training centers remains very important in the training of beekeepers with 44,33%. The largest number of beekeepers identified are professionals (Fig 2) who have practiced this profession for more than 15 years. Other

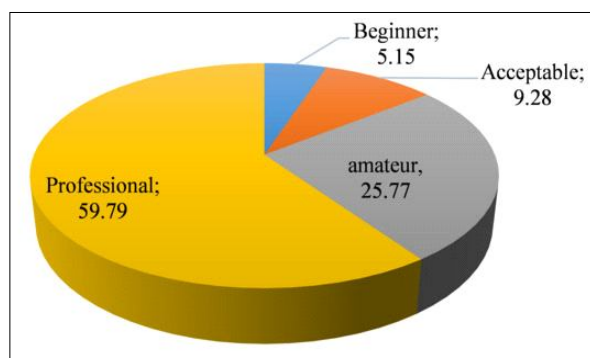


Fig 2: Quality profiles of beekeeping practices.

categories have less than five years or less than one year for beginners.

Structure and composition of bee yards

During our surveys, we counted more than 5700 hives, 45.36% of hives belong to professional beekeepers with more than 80 hives each. 83.43% of hives are in an excellent condition, 48.45% of beekeepers ensure that there are equal numbers of frames within the hives while 38.14% keep a fixed number for each hive.

The location of the bee yard is important and depending on the variety of reliefs presented in the study sites, 39.18% of beekeepers place their apiaries close to cultivated fields, followed by mountainous areas, forests and grasslands with 28,87%, 21,65% and 10,31% respectively. These relief formations offer a multitude of plant cover diversity including wild plants (46,39%), fruit trees (27,84%), forest trees (14,43%) and agricultural crops (11,34%).

In spite of the observed diversity of plant types, melliferous crops are insufficient for feeding bees, this is granted by 47,42% of beekeepers which creates a bees nutrition issue despite the fact that the water source is close to bee yards in more than half of beekeepers.

• Beekeeping work

According to the observed shortage of the melliferous plants, transhumance is practiced by more than 80% of beekeepers, these latter follow the beekeeping work calendar for each season while respecting the particularities, methodologies and practices for each period.

In addition, more than 70% of the beekeepers prepare their bees before the unfavorable season by maintaining the hives, cyclical check of the apiary, disease prevention and feeding.

Professional beekeepers practice an artificial feeding for the bees based on several elements depending on the season. The sweet syrup with different concentrations in spring period, the beebread, the sweet paste and the protein paste in autumn period. The quantity and rate of feeding is evaluated by the beekeeper according to the structure of the colony and the food reserves within each hive.

• Hive products and their marketing

After the hive products ripening, it is the harvest time. The honey goes through a series of operations to make it edible and marketable. Starting with the uncapping step that consists in removing the wax film that closes the honeycomb. Secondly, the extraction with a centrifugal extractor. After that, a centralizing decanter is used to allow the honey separation from the different impurities that it contains in suspension by the difference of density existing between these bodies. Then, a maturator is manipulated to let the honey settling. Finally, honey can be packed in jars. All these equipment are available at 63,92% of beekeepers. More than 69% of practitioners harvest honey three times during a beekeeping year.

The most commercialized products of the hive are honey, royal jelly and pollen (Fig 3) Honey is the most

collected element with 87.88%, followed by royal jelly (8.09%) and pollen (4.03%). Financially, 63.04% of beekeepers confirm that honey is the most sold and profitable product. However, royal jelly is in the first place for others (31.87%), the pollen comes first for the rest.

The marketing of the products, which is difficult for half of the beekeepers, is ensured very significantly through the recommendations and the exhibitions to a lesser extent.

• The hive pests

Many animals cause a permanent threat to the bee's life in their hives such as mites, insects, forest mammals, reptiles and birds. For our beekeepers, four categories of animal pests are listed: the mite *varroa destructor*, the wax moth *Galleria mellonella*, rodents and birds (Fig 4).

The *Varroa destructor* represents one of the greatest threats to modern beekeeping, notably because of its life span, which is adapted to the life cycle of the bee. More than half of the beekeepers (55.67%) suffer from this ectoparasite because all the colony members are targeted at all stages of their development (larva, nymph and adult).

Many birds take the foragers in flight. These are mainly swallows and chickadees. And according to 22,68% of the beekeepers the green woodpecker manages to damage the wooden hives and to eat honey from the combs. The noise caused by its beak strikes makes the bees rustle.

A small part of the beekeepers 12,37% , suffer from rodents, mainly field mice. The rest of the beekeepers have hives affected by the wax moth.

These pests require intervention to reduce their danger. For this and if a hive suffers, the breeder uses the appropriate treatment; this is confirmed by more than 70% of our beekeepers. The treatment is modern for more than 60% of the beekeepers, who they cited the example of varroa control, which consists in placing the anti varroa strips as close as possible to the brood during the autumn period and the period prior to the spring honey harvest. This, has given remarkable results.

For the rest of the breeders, a combination between what is available on the market and natural remedies is used.

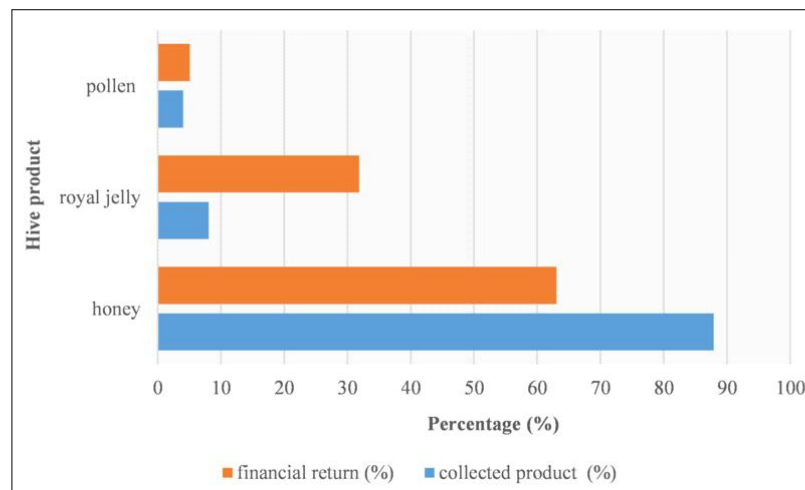


Fig 3: Variation of the hive products (Honey, royal jelly and pollen) between production and financial return.

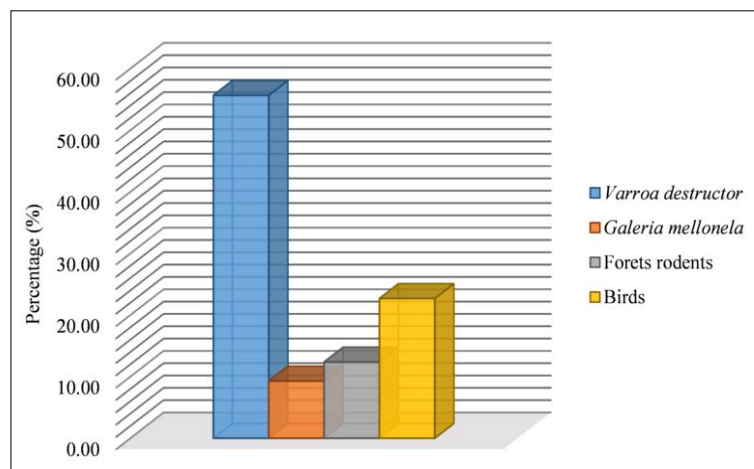


Fig 4: Most serious pest's hives in the two study sites.

• Problems encountered and relationship with the beekeeping world

Losses caused by pests are recoverable for 46.39% of beekeepers. While for 31.96% can cause the bankruptcy, these last ones already present financial problems

More than half of the beekeepers confirm that their main problem is climate change and that the winter season is the hardest.

The beekeeper and the farmer in Algeria can obtain the professional card of fellah in order to benefit from the benefits of agricultural mutuality funds, as well as the cooperatives of cereals and dry vegetables, without needing administrative documents. But unfortunately, 43.30% of our beekeepers do not have it.

Half of the beekeepers qualify the relationship between their colleagues as cooperative. Where they cooperate with each other, help beginners, motivate others to do their best, overcoming difficulties and conflicts, provide their services for training, knowledge or even marketing. In other hand, 14.43% do not have any type of relationship with others.

The work of associations that gather beekeepers for a better beekeeping world have as objectives to sustainably improve the hive products and access to quality inputs, a better valuation of the hive products on remunerative markets and finally to develop and sustain an service offer adapted to the needs of beekeepers and their territories. However, unfortunately, more than half of our beekeepers do not even belong to these associations.

Lefèvre-Lafargue *et al.* (1973) have shown that all Mediterranean countries are suitable for beekeeping. The diversity of the Algerian flora and the relative softness of the climate allow in certain regions of the littoral successive honey flows spreading over a great part of the year. Algeria is rich in beekeeping possibilities. The Algerian bee is well acclimatized to different ecosystems. It has an abundant spontaneous and cultivated melliferous flora.

• Algerian beekeeping

(Souissi and Bedoui, 2020) confirm that Algeria with its vast territory hosts two bee species: The tellian bee and the saharan bee.

The tellian bee (the black bee) or *Apis mellifera inetrmissa*, which has a wide distribution on the Algerian tell where the diversity of meliferous plants is impressive. It is known for its aggressive nature, excessive swarming power, sensitive to disease and able to cover just 3 km, but also very fertile and a good pollen and propolis harvester. The Saharan bee (the yellow bee) or *Apis mellifera sahariensis*, which is distributed in the region extending from el Bayadh to Beni Abbas passing through Nâama, Ain Safra, Beni Ounif and Bechar. It is known for its gentleness and its good frame behavior prolificacy, lack of aggressiveness, extraordinary nectar and pollen harvester, ability to travel more than 8 km and easy acclimatization under difficult climatic conditions.

Beekeeping in Algeria was always a subject of research for scientists. In order to promote this field, many studies

have been carried out to deepen knowledge and solve problems, whether for bees, beekeepers, melliferous plants or hive products.

A great deal of beekeeping research has been carried out in the western region of the country, whether it be on the quality of honey derived from floristic diversity (Boucif, 2017) or on the nature of the mechanisms modifying the physiological aspects of the Tellian bee (Mersaoui, 2020). In the same year, honey was still the subject of in-depth research into its production and consumption in the Greater Kabylie region of Bouira (Mansouri and Ouarou, 2020) and Tizi-Ouzou (Bouhouf, 2020).

Northern Algeria, with the exception of certain regions, has very extensive and varied honey resources that allow a blow on an extension of agriculture. Nine regions of the north are undoubtedly very rich in beekeeping possibilities; they are Algiers, Oran, Mostaganem, Chlef, Constantine, Annaba, Tizi ousou, Tlemcen and Sétif.

We proceeded to a survey in two regions of northeastern Algeria: Constantine and Mila, which are renowned for their diversity of plant cover and their melliferous flora, we interviewed more than ninety beekeepers and they answered thirty hierarchically structured questions

• Algerian beekeepers and hive products

Men are the most active beekeepers, the age group ranging from 20 to 50 years receives the highest percentage of practitioners and this is already confirmed in the tellian (Berkani and Khemici, 2018), desert (Ksouri, 2019) or arid areas (Ziane and Brikat, 2020).

The majority of beekeepers are professionals, but a number of them are beginners who need academic training or workshops and advice from experts in the field for better understand beekeeping practices to increase their hives number.

Types of hives are not the same for all the beekeepers; sometimes it is different for the same breeder. Overall, it varies between Dadant and langstroth with a predominance of Dadant. Berkani (2008) discussed a study of the tellian bee, hive and melliferous flora at several locations of northern Algeria and confirmed that the financial benefit of the Dadant hive is far greater than that of Langstroth.

The nature of the melliferous flora presented in the two study sites is varied, but remains insufficient for the bee's food at most of the beekeepers. For that, it will be necessary: to know better the melliferous flora from which the bees get their substances and to determine a correct naming of the honey, increase the study frame with a larger sample. In addition, the establishment of a phytogeographic map and a pollen atlas with associated identification keys representing the species of beekeeping interest in the study sites and even for the country in order to better valorize and develop the resources.

Almost all beekeepers supply the market with honey, royal jelly and pollen.

In general, honey is the most commonly harvested product from beehives. A study in Ethiopia (Chimdesa *et al.*,

2020) showed that two honey flows are identified. For both study areas, several harvests are possible, up to five per year for some beekeepers who practice transhumance in other locations.

Only 12.61% of them have created a combination between propolis and carob tree leaves to have an easy to digest element for medical interests.

Wax is the basic element of the hives. Due to the lack of means and initiative for the wax renovation, two thirds of the beekeepers keep the same slices of the built up wax from one generation for the new generations and this through several years until the total transformation of color or the appearance of fractures. At this stage, the breeder gets rid of the wax.

Since the pandemic of COVID-19 Algeria has suffered a terrible drought. This was visible on the beekeeping production, which had decreased. In addition, during the quarantine in 2020, beekeepers who follow primitive ways to sell their products like recommendations and exhibitions had extreme financial problems.

E-commerce is very important for the dissemination of products, but due to the limited cultural level of most of the breeders, this seems to be very difficult to achieve. Less than twenty beekeepers have an online page to display and sell their products.

• Hive pests and problems encountered

The enemies of the hives cause a permanent threat to the social life of the bees. Intervention is always requested with adequate solutions.

Varroa destructor poses a constant threat to the social life of bees despite the efforts of scientists such as Vijayan *et al.* (2023), who used extracts from several plants endemic to India to evaluate and test their effects on this parasite. The results were highly significant.

However, this is not the case for the beginner beekeepers, who do not know how to deal with the varroasis or the moth and prefer to suppress totally by burning the invaded hives. This decreases the total yield of the apiary and implies a financial deficit. These beginners have to get closer to the professionals and the latters have to guide them.

Despite Africa's enormous potential for beekeeping production, namely its diverse climate and plant resources, there are many marketing problems, especially for the most requested commodity: honey. Goshme and Ayele in 2020, listed several constraints in Ethiopia, such as: Pests, climate issues, food shortages for bees, shortages of skilled labor, equipment shortages, poor management practices, chemicals, weak research and extension services, inadequate infrastructure, low awareness of post-harvest handling, lack of technology, etc.

Climate change has always had an effect on living beings and the ecosystem. the world of bees is not immune as described by Samanta *et al.* (2024), where they confirmed this influence on the quality of fruit from plants with a short flowering period pollinated by bees. They also proposed

several short- and long-term solutions, such as promoting the number and diversity of pollinating bee species.

Beekeepers have confirmed their inability to cope with extreme weather conditions, especially during winter nights when temperatures can drop below zero, also during very hot days in July. They have opted for early intervention, which consists of preparing the hives for extreme weather conditions by covering the frames with burlap or polystyrene, ensuring a diet rich in protein and not visiting too often in winter. Providing a renewable source of water and ensuring a source of food when the ground is completely dry, which can be useful in most cases.

The work of associations and cooperative that gather beekeepers for a better beekeeping world is very important. such as the one in Morocco (Mohssine *et al.*, 2020) which showed the importance of cooperatives in the collective forms of beekeeping production and the involvement of rural youth and women in decision-making processes. The beekeeper must be aware of the associations' roles by being a member in an objective way for his interest, self-training, participation in the beekeeping days organized by the sectors of agriculture, environment and university, vigilance against enemies and diseases of the hive, increasing knowledge in the field of beekeeping, plants and financial management.

CONCLUSION

The Mediterranean climate provides a favorable habitat for honeybees, with a diverse range of nectar-producing plants. This is the case for the Tellian bee (*Apis mellifera inetrmissa*), which is found in northern Algeria. Continuing training for beekeepers is necessary in order to master the problems encountered. Honey is the most widely harvested product, but it is necessary to focus on other products given their nutritional and therapeutic value. Integrated pest management involving experts must be applied to combat diseases and pests affecting beehives in order to preserve this precious species, ensure the balance of the ecosystem, and above all, avoid polluting the environment.

Conflict of interest

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

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