Value Added Products for Beekeepers in Albania

Daniel Cane
Meghan Dawe
Joseph Ostrowski
Allison Rivard

Sponsoring Agency: Rural Association Support Programme (RASP)

Date: December 20, 2014

Advisor: Peter Christopher

Project Number: PRC 3249

Division Number: 49

Value Added Products for Beekeepers in Albania

An Interactive Qualifying Project
submitted to the faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
degree of Bachelor of Science

Submitted By:

Daniel Cane
Meghan Dawe
Joseph Ostrowski
Allison Rivard

Date: December 20, 2014

Abstract

Beekeeping is a popular and growing craft in Albania, in both urban and rural areas. Beekeepers face many challenges including maintaining their hives, processing hive materials, and selling their products. This project, sponsored by the Rural Association Support Programme, focused on addressing ways for beekeepers to benefit more from their efforts. Our team conducted experiments to test ways of dissolving propolis, cleaning wax, crafting molds, and making simple cosmetics. We determined feasible and efficient methods for beekeepers to create value added products. Our findings are summarized in educational pamphlets and guides for distribution among beekeepers in Albania and online. These materials provide information for beekeepers to improve their practices to better their livelihoods.

Acknowledgements

Our team would like to thank everyone who has contributed to the success and completion of this project. We are grateful for your guidance throughout this experience, as without it our project would not have been possible.

- Our advisor and the Albania project site director, Professor Peter Christopher
- Sponsoring Agency, Rural Association Programme (RASP)
- Our sponsor liaison, Petrit Dobi
- Our ID2050 instructor, Professor Hersh
- Lab manager at Universiteti Bujqesor I Tiranes, Marsel Keci
- Local beekeeper and head of Albanian Beekeeping Association, Lejla Shehu
- Local beekeeper, Kujtim
- Executive director of the Association for Gender Integration, Lindita Çeçja
- The Albania project site local coordinator, Frida
- Local Borderless volunteer, Sindi Dobi
- Our WPI project librarian, Rebecca Ziino
- President of the Worcester County Beekeeping Association, Norman Mercier
- Member of WCBA and Massachusetts state bee inspector, Ken Warchol

Our time preparing for this project at WPI and our time spent in Albania has been enjoyable and memorable. Thank you for your support as this project has grown and evolved.

Executive Summary

The Balkan nation of Albania is a mountainous country filled with rich history and geographical beauty (Bradbear, Hilmi, & Mejia, 2004). Farming and other rural industries, such as beekeeping, are a large focus in Albania as 42% of the land is used for agriculture and 57% of the population lives in rural areas (IFAD, 2010; Misha, 2014). Beekeeping has seen tremendous growth in Albania with hive numbers increasing by 287% between 2000 and 2010 (Dobi & Shehu, 2012). Though apiculture has been a vital and predominant part of Albania's rural economics for over 2000 years, currently beekeeping is mostly practiced on a small scale (Aguiar, 2008); (Dedej, 2000). During communism, the beekeeping sector was controlled by the government and supported by specialized institutions (Dobi & Shehu, 2012). Although the fall of communism allowed beekeepers to create their own businesses, the lack of control and support from the government created gaps in the apiculture infrastructure.

Beekeeping is a profitable activity capable of improving the livelihoods of individuals and rural communities (Lietaer, 2009). Beekeepers can expand their efforts by exploring the production of advanced products. Value added products processed from raw hive materials such as propolis and wax can be sold at a higher price. Bees collect propolis, also known as bee glue, a material made of resins, wax, and minerals. Quick and effective dissolving is one of the main challenges associated with processing propolis. Wax is often either discarded or made into comb foundation sheets for hives, however it can be used to produce profitable candles and cosmetics. A lack of knowledge surrounding opportunities for using less abundant hive materials hinders beekeepers' ability to create value added products.

The goal of our project was to investigate current beekeeping practices in Albania and create educational resources about value added products. We interviewed local beekeepers from Tirana to determine their current practices. We also interviewed people in organizations involved with educating beekeepers. These interviews helped us to better identify beekeeping related challenges. The next objective was to research the

techniques for creating value added products. We determined many methods of processing wax and dissolving propolis. Our third objective was to assess the feasibility of creating selected products in Albania. We determined the resources that were available locally. We conducted lab experiments with propolis to identify the dissolving efficiency of both high quality and practical solvents. We also created candles, candle molds, and cosmetic products to establish simple step-by-step instructions. Our final objective was to create long lasting educational resources for beekeepers. We produced pamphlets in English and Albanian and more detailed guides on how to harvest and purify propolis, make candles and their molds, and create a variety of cosmetics. The guides and pamphlets incorporated the conclusions from our tests and relevant background research. The pamphlets display our recommendations in a concise format for beekeepers to read quickly while the guides provide extensive instructions.

Each product we tested had specific results and recommendations. From our research surrounding propolis, we learned about two processes of extraction; scraping and using propolis traps. We recommend installing propolis traps to collect larger quantities of high quality propolis. We found grating frozen propolis was more effective than grinding or smashing propolis, but it requires much more effort. To maximize the surface area and thereby minimize the dissolving time, we recommend grating whenever possible. Once the propolis is in smaller pieces, most beekeepers dissolve it in ethanol, a process that can last up to two months. We determined from our experiments that diethyl ether works significantly better than ethanol. We recommend scientists investigate diethyl ether in terms of its safety and effect on propolis components. Also, we found that a mixture of equal volumes of ethanol and olive oil has a comparable dissolving rate to ethanol. We recommend beekeepers experiment with an olive oil and ethanol mixture depending on their desired final product. After dissolving propolis for two weeks, we tried various filtering methods. While we found that *frazelinë* was our most successful filter material, other fabrics such as chiffon functioned adequately.

The first step to make candles is cleaning the raw beeswax. While filtering can be done, it was easier to heat wax and water in a double boiler. Cooling this mixture allowed solid debris to settle on the bottom of the wax and be removed. Beeswax can be colored with commercial dyes and natural herbs. We recommend beekeepers add natural herbs to the wax during the heating process and letting the herbs settle to the bottom of the wax during the cooling process. This is an affordable method that allows beekeepers to use accessible resources. For novice candle makers, we recommend making tapered candles, rolled candles, and jar candles, as they are easy and require minimal materials. For beekeepers who wish to make custom candles, we recommend making molds rather than purchasing expensive premade molds from other countries. High quality silicone rubber is the recommended mold material as it is reliable and successful. Silicone caulking can be used as an affordable alternative though its molds are of lower quality. Paper molds are successful in making geometric candles but are not reusable. 3D printed molds could be used to make molds at a relatively low cost. Although the materials for 3D printing are available in Albania, they are not accessible for everyone.

Beeswax based cosmetics require very clean wax. Wax retrieved in the spring is the purest produced by bees; therefore it is preferred for cosmetics. The cleaning process should be repeated several times. Because of limited time and materials, we focused on creating lip balm, cold cream, and lotion. While lip balm was easy make, it required almond oil which can be expensive in Albania. The cold cream required only beeswax, olive oil, water, and vitamin E; however, it had a multistep production process. Lotion was the most time consuming to make of the three cosmetics and required more expensive materials. While ingredients can be found in pharmacies, the prices are sometimes very high for small quantities. While we recommend each of these three cosmetics to beekeepers, each has benefits. We recommend lip balm to beekeepers with minimal beeswax, cold cream to beekeepers with limited funds, and lotion to beekeepers who have the resources and are looking to make a more profitable and marketable product.

We compiled our recommendations into pamphlets, instructional guides, and a formal lab report. We received feedback from local beekeeping experts regarding the formats of our recommendations. We recommend that our sponsor distribute these pamphlets both electronically and manually to organizations involved with beekeeping projects. We recommend uploading the instructional guides online on RASP's website and extension page to be available for beekeepers in throughout Albania. With these recommendations focused on feasibility, beekeepers have the information to increase their product variety and potential profitability.

Authorship

As a team, we developed a method in which everyone participated in writing and editing a portion of each section in this report. Sections were written individually or in pairs and edited and commented on by other team members. Then as a group we compiled and finalized each section. While each member took part in all the experiments that were conducted and read each section of our report, Allison and Joseph focused on propolis, Meghan focused on candles, and Daniel focused on cosmetics. This separation of attentions allowed for each member to concentrate on one aspect in great detail, as well as verify that other aspects were being presented in a manner that provides a clear understanding for someone who does not have expertise in that area. This working dynamic allowed for every member to be a researcher, organizer, leader, writer, and editor in this project and in the creation of this project report.

Table of Contents

List of Figures

List of Tables

1. Introduction

Apiculture, also known as beekeeping, is a well-developed industry in the United States, with varying levels of involvement including commercialized, intermediate and hobbyist beekeepers (Mercier, 2014). While there are individuals who practice beekeeping on a large scale in Albania, 63% of hives are owned by hobbyist beekeepers, or people who maintain less than ten hives (Dedej, 2000). Apiculture is a popular subsidiary industry to Albania's agriculturally dominant economy. Honeybees increase agricultural production through pollination and produce substances in their hives that are used to create important products (Aguiar, 2008). However, hobbyist beekeepers face challenges in making their small-scale efforts economical and profitable. Our sponsor the Rural Association Support Programme, referred to as RASP, is one Albanian organization aiming to improve beekeeping efforts. RASP hopes to help beekeepers improve their livelihoods through encouraging the production of more profitable products.

Other countries have successfully expanded beekeeping practices by processing raw hive materials to make value added products (Crowder & Harrell, 2012; Dirina & Bugina, 2012). There are some beekeepers in Albania who produce and sell advanced products such as royal jelly, candles, and propolis tinctures for additional profit (Dobi, 2014). However, most do not create these products as there is a general lack of knowledge among Albanian beekeepers surrounding standardized approaches. Creating and distributing educational resources is one way to address this issue. These resources can inform beekeepers of the various methods of creating high quality products. The production of value added products is a sustainable way for small-scale Albanian beekeepers to expand the apiculture industry.

The goal of our project was to investigate Albania's current beekeeping practices and provide recommendations for creating value added products using improved methods that are both accessible and relevant to beekeepers. We researched many methods for processing wax and propolis into consumer products. Our project's focus

evolved into improving production techniques of value added products, specifically propolis extracts, beeswax candles and natural cosmetics. To ensure that our recommended methods were practical in Albania, we tested various aspects including access to resources, cost of production, and simplicity in creation. We explored how to decrease the dissolving time of propolis by increasing the surface area of propolis samples and testing different solvents for dissolution. We tested both concentrated chemical solvents and combinations of more accessible materials. For beeswax candles, we investigated various methods of cleaning and coloring wax, creating simple candles, and making molds for elaborate candles. Lastly, we made three different cosmetics involving beeswax, a lip balm, cold cream, and moisturizing lotion. From our research and testing, we created concise pamphlets, detailed guides, and scientific lab report to best distribute our results and recommendations.

Our overall goal was to educate beekeepers about updated and efficient techniques for producing beekeeping products. The educational resources we created are posted online and distributed through local organizations to reach a larger audience of beekeepers in Albania and beyond. Ultimately, the advice provided could help beekeepers sustain their efforts, increase their profits, and improve their livelihoods.

2. Background

This chapter introduces the state of beekeeping in Albania today and many of its influencing factors. We also examine strategies and efforts that aim to improve beekeeping practices in other countries. Our team analyzes the effects that economic and historical factors have had on agriculture and beekeeping in Albania. Next, we investigate different strategies and techniques that previous beekeeping programs have used to improve beekeeping in rural areas across the globe. Then we consider the various challenges that beekeepers face in producing value added products. Lastly, we discuss our sponsor agency, the Rural Association Support Program (RASP), to identify their mission and how our project addresses their goals. This information provides an overview of how Albanian beekeeping has grown over the years and how education of practical techniques can improve the current standard.

2.1 The Effect of Land-Related and Historical Factors on Albania's Economy

2.1.1 Geography of Albania

The Balkan nation of Albania is a country filled with rich history and geographical beauty. Albania borders the countries of Montenegro, Kosovo, Macedonia and Greece. Its coastline is nestled against the Adriatic Sea along with the Ionian Sea. Albania's 29,000 square kilometers consist of agricultural land and mountains (CIA, 2014). 75% of the country is hilly or mountainous (Bradbear et al., 2004). Seven of the eight mountains, indicated by the triangles in Figure 2.0, are greater than 2000 meters high. Transportation time throughout Albania is often elongated because of these mountains. This physical barrier can prevent the exchange of information, technology, and goods between regions within the country (Pieroni et al., 2014).

Figure 2.0: Albania physiography (CIA, 2014)

The mountainous geography has played an influential role in the dominant agriculture sector of Albania. Farming is a vital industry as 24% of Albania's land is devoted to agriculture alone (Bradbear et al., 2004). Most of the agricultural farming is done in the west near the coast, as the majority of the mountains are located on the eastern side of the country. Figure 2.1 shows how the counties of Vlore, Berat, Lushnje and Shkoder permanently harvest crops such as olives, grapes and citrus produce while

villages in western counties focus on mixed farming such as grains, potatoes, vegetables and livestock. This sector in Albania accounts for almost 20% of the overall gross domestic product (CIA, 2014). Although agriculture is a large industry, other supplementary businesses are growing in Albania. The country provides a climate and landscape that is beneficial to the beekeeping industry (Mullin et al., 2010). Beekeeping is not only a profitable activity that generates desired products, but also greatly benefits existing agricultural practices as a result of increased pollination.

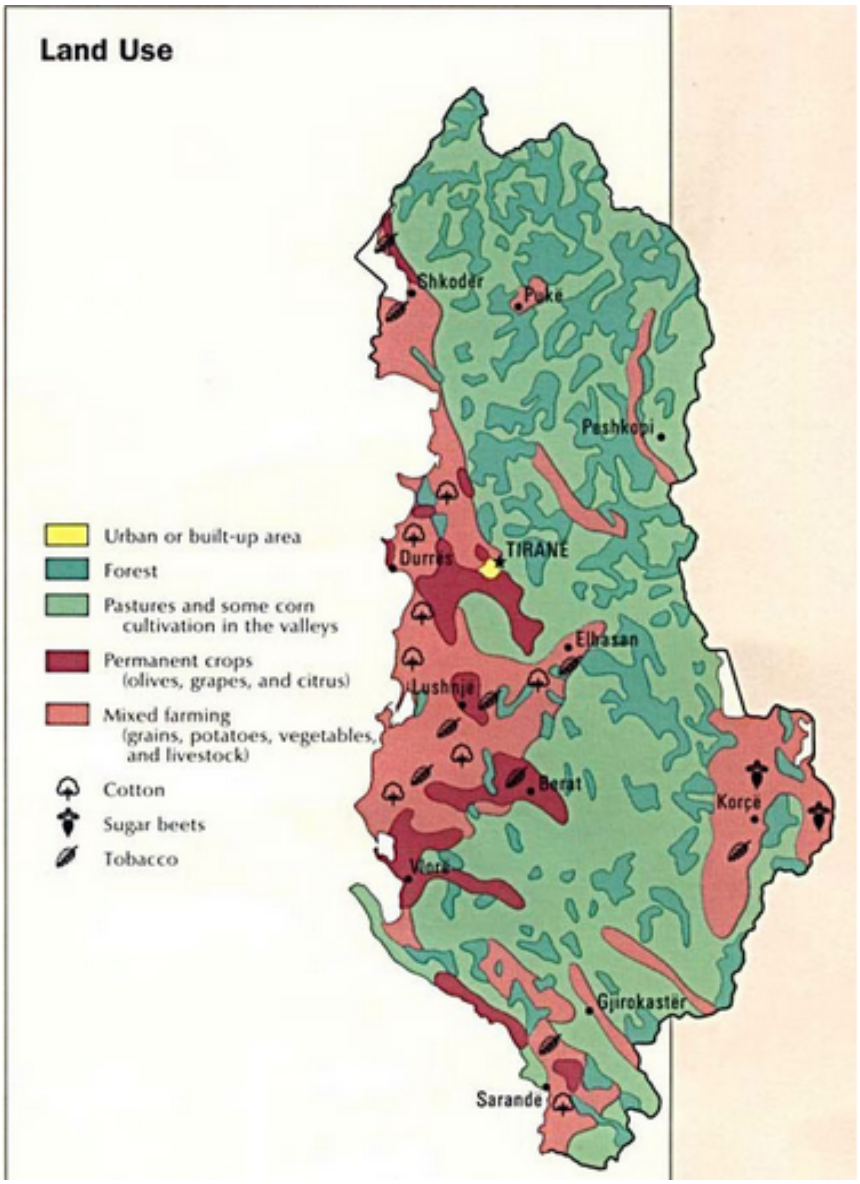


Figure 2.1: Regional land use (Bradbear et al., 2004)

2.1.2 Ownership of land

When the communist regime took control in 1946, a land collectivization process was implemented. This process pooled a community's land, machinery, and livestock together to form larger, government-operated farms and agricultural production cooperatives (Koprencka & Muharremi, 2010). By 1976 all land was nationalized by the government; of the available land that was suitable for farming, 78% was cultivated by individuals who were a part of agricultural production cooperatives and 21% was government run farmland (Cungu & Swinnen, 1999). Shortly after the fall of communism in 1991, the Law on Land was created to help privatize Albania's arable land (Sikor, Muller, & Stahl, 2009). Albania's 7000 km^2 of cultivable land was distributed among 470,000 households, with each family receiving around 0.012 km^2 on average (Kodderitzsch, 1999). However, this redistribution process was difficult. Only 77% of all farmers were given land, of whom less than a quarter received land they previously worked; the other 23% under this new law were forced to give up the land they had worked during communism (EuropeanCommission, 2006). This reorganization created conflicts between the land's new and previous owners (EuropeanCommission, 2006).

Some individuals perceived the land dispersal as unfair and participated in widespread riots that damaged land plots and existing agricultural structures (Hall, 1998). The distribution of relatively small plots of land coupled with the destruction of farmland, agricultural structures, and equipment caused farmers to migrate out of rural areas (De Soto, 2002). This migration and fragmented countryside left remaining farmers isolated. (Sikor et al., 2009). This isolation restricted rural markets and limited farmer's profits because not enough consumers were able to purchase their products. In addition, the collapse of former agricultural and industrial enterprises and cooperatives, supply networks, and distribution channels left rural Albanians with little support for their stagnant industries (De Soto, 2002). Poverty-stricken and lacking support, many would look to other areas inside or outside the country for new economic opportunities to create better lifestyles for their families.

2.1.3 Immigration and emigration

With the fall of communism, a difficult transition period for Albania began as "the quality of rural life, already the lowest in Europe, plummeted further" (Hall, 1996). The uneven division of land into a fragmented system brought upon a decrease in food production, an increase in crime rates, and economic instability (Hall, 1996). In 1992, 65% of Albania's population lived in rural areas and over half of the country's population was employed in the agricultural industry (Cungu & Swinnen, 1999). With food scarcity, crime, and economic issues developing, many families began exploring new options to find a way to mitigate these effects on their livelihoods. As a result, there was an influx of rural to urban migration as well as emigration out of the country. In 1993 alone Tirana's population increased by five percent as migrants came from rural areas (Hall, 1996). "Between 1990 and 1993… almost ten percent of Albania's total population succeeded in leaving the country," to escape the "low domestic income levels" (Hall, 1996). Currently emigration remains a popular trend; Albania has the highest emigration rate in Europe at 29% while other countries are around ten percent (UN-DESA & OECD, 2013). This shows that Albanian people are still seeking ways to improve their lifestyles. It is more economically beneficial for some people to find work outside of the country than to continue what they are doing in Albania (De Soto, 2002). While some individuals view leaving the country as the best option, others have been finding alternative ways to improve or supplement their economic endeavors to raise their standard of living.

2.1.4 Expanding Albanian rural economics

A gap in the rural economy still exists as the rural population has declined from 65% in 1992 to 57% in 2010, with many people still looking elsewhere for economic opportunities in Albania (IFAD, 2010). During the governmental transition period there was widespread destruction of support organizations, distribution channels, and industrial cooperatives; this disorder lead to a lack of educational support, technology, and accessibility to markets for rural community members (De Soto, 2002). These issues intensified the already existing poverty conditions (Hall, 1996). The population in rural

regions can benefit from new sustainable sources of income to enhance their earnings (Bradbear, 2009).

Apiculture, or beekeeping, can help stimulate the economy of a rural community and improve the livelihood of its members. Beekeeping does not require much startup capital costs to begin nor an abundant amount of time, which makes it an ideal industry to implement in a rural community (Bradbear, 2011). Beekeeping is a very sustainable activity; it can augment current agricultural practices to produce higher yields while also generate lucrative products (Bradbear, 2009).

2.2 Developing Beekeeping to Improve Livelihoods in Rural Communities

Beekeeping support initiatives and programs have been implemented in developing countries around the globe (Nel, Illgner, Wilkins, & Robertson, 2000). Figure 2.2 shows locations of a single organization's project efforts to launch bee initiatives.

Figure 2.2: Beekeeping initiatives launched in developing countries by Bee World Project ("Bee World Projects," 2014)

This is not the only organization that has increased the profitability of beekeeping for individuals and rural communities (Bradbear, 2011). Some common themes that have contributed to the success of these beekeeping programs include:

- Utilizing associations effectively
- Improving marketing techniques
- Expanding services provided
- Creating products that are more valuable

In many cases one or more of these strategies played a role in the multifaceted improvements that the beekeeping program had on individuals and the community (Lietaer, 2009).

2.2.1 Utilizing associations effectively

In almost every country across the globe, beekeeping is used as a sustainable method to improve the livelihood of individuals (Bradbear, 2011). Over time beekeepers have formed organizations and associations to improve techniques and share knowledge as needed in a specific community. In the United States a market economy is well developed. Therefore most associations, including the Worcester County Beekeeping Association of Massachusetts, focus on providing education for its members to understand more about honeybees and safe beekeeping, rather than offering services to help sell products (Mercier, 2014). Educational services are a necessary component of almost every organization or association that aims to improve beekeeping practices in a specific area.

However, in rural areas of developing countries it might not be so easy for individuals to sell their products. Therefore associations must also focus on aiding their members in accessing markets to increase their profitability. During an initiative project in a village in Zimbabwe, the Bondolfi Beekeepers Association (BBA) was created to help new beekeepers gain access to supplies and aid members in finding markets to sell their products (Nel et al., 2000). Those were the aspects lacking in the community's beekeeping industry that could be improved. Initiating an apiculture project in a rural, developing community can be more successful if an organization or association provides services that the individual beekeepers cannot do by themselves.

2.2.2 Improving marketing techniques

Beekeepers who sell their hive byproducts must also consider how they package and market them to customers. A study polling over 500 customers looking to purchase honeybee products was done in Poland to determine influencing factors in making a sale. Regarding the aspects that impact a customer's decision to purchase honey, the

visual features of the container matter to 57% of the customers while the cleanliness of the packaging mattered to 34% of the customers (Roman, Popiela-Pleban, Kozak, & Roman, 2013). These are important factors that small-scale beekeepers need to focus on as most package their products in recycled glass or plastic containers (Bradbear, 2011). It is essential that the packaging be functional, yet also have a visibly appealing container with a label that depicts when and where the honey was made, as people are more willing to purchase locally produced items (Popa, Mărghitaş, Arion, & Pocol, 2012). In the Polish study 88% of respondents said they preferred to purchase domestically made honey (Roman et al., 2013). With these packaging enhancements, local beekeepers can increase their products' appeal.

Another important aspect is the information included on the packaging. The Polish study revealed that 68% of participants were interested in knowing more information about the medicinal purposes and health benefits of honey and other products (Roman et al., 2013). In addition 77% said they would pay more to guarantee the source of the honey is reliable (Roman et al., 2013). Beekeepers should focus on selling their goods in a manner that allows them to feature the advantages of buying local hive products and emphasize the origin.

2.2.3 Expanding services provided

A common theme of effective beekeeping projects is to have existing beekeepers provide more services to the community to increase revenue. A profitable service that can be offered is pollination rentals (Hoff, 1994). It is estimated in the United States that 25-30% of all honeybee colonies are transported to farms to pollinate crops annually (Hoff, 1994). A case study done in Romania points out pollination services is a profitable option, as "insect pollination is an ecosystem service with high economic value that is mainly provided by bees" (IMF, 2014; Popa et al., 2012). An instance of colony rentals in the Netherlands demonstrates how a beekeeper would profit one and a half times more per hive if they charged a flat rate per hive rental, rather than just maintaining the hives in their apiary (Bradbear, 2011). If there is a strong agricultural economy in a rural community then pollination services could become a profitable endeavor.

Another service that could be provided is the production of hive equipment and protective materials. The necessary tools for common beekeeping practices can typically be made at any village level (Bradbear, 2011). If a community has a dense population of beekeepers the demand for hive materials could create a profitable side income. These two services are possible options for individuals looking to expand their beekeeping activities.

2.2.4 Creating products that are more valuable

The main way to improve the creation of valuable apiculture products is through educating beekeepers. During a beekeeping improvement program in Ethiopia top-bar hives, a more functional and modern hive structure, were used to replaced hives made from tree trunks; because of these changes a larger yield of higher quality honey was cultivated (Bradbear, 2011). Organic techniques and processing methods can also contribute to making better quality goods and attract customers who seek organic foods (Crowder & Harrell, 2012). There are accredited certification agencies around the globe that can certify that beekeepers have the ability to create organic products (Bröker, 2003). Depending on the supply and demand of honey, organic honey has previously earned up to 15% more than regular honey in European markets (Bröker, 2003). Increasing the quality of a product is a way to increase its value since it could be sold at a higher price.

Beekeepers should also consider harvesting less abundant hive materials to create value added products. Products made from wax, propolis, and other hive substances are often referred to as value added products as they can be sold for a higher cost. Substances such as propolis and royal jelly take a longer time to harvest and process into a consumer product (Ballot-Flurin, 2012). Both are produced in the hive; propolis is commonly referred to as “bee glue” and royal jelly is the food source to feed developing queen bees (Warchol, 2014). These items have been used to create medicinal remedies to treat medical issues such as cold symptoms, allergies, and skin injuries (Krell, 1996). The 2012 International Scientific Conference, held in Latvia, revealed that in the year 2010, bees wax sold for almost three times the price of honey,

and propolis tinctures sold for nearly seven times the price of honey (Dirina & Bugina, 2012). This result shows the profitability of advanced products that take longer to process. Therefore harvesting hive materials to make valuable products is another economic option for beekeepers to pursue.

2.3 Propolis as a Value Added Product or Ingredient

2.3.1 Propolis and how it is harvested

Propolis is a complex substance; it is a mixture of beeswax, resins and compounds collected from plants, flowers, and leaf buds (Krell, 1996). Bees collect these ingredients on their body while foraging for pollen and nectar as seen in Figure 2.3.

Figure 2.3: The red substance is propolis (DevonBeekeepers'Association, 2011)

Every sample of propolis has a unique chemical composition since the variety of available plants differs for every hive (Bankova, 2005). This means that the composition of beeswax, resins, and active components that bees collect to create propolis will greatly depend on hive location.

Honeybees use propolis to disinfect and protect the hive (Crowder & Harrell, 2012). It is used as a building material to fill unwanted gaps and block entry points of the hive to keep out other animals and insects (Bankova, 2005). In addition, it is used to line brood combs, where bee larvae develop into adult bees, and to capsulate any unwanted animal or insect that died in the hive (Krell, 1996). Scraping raw propolis off of the surfaces of the hive with a common metal tool is one way to collect propolis, as seen in Figure 2.4. However, propolis collected by scraping typically contains large

quantities of wax, dirt, and other undesired residues (Berry, Hood, Pietravalle, & Delaplane, 2013).

Figure 2.4: Scraping propolis from a frame (Cane, Dawe, Ostrowski, & Rivard, 2014)

Beekeepers who want to collect larger amounts of cleaner propolis use propolis traps; these grids seen in Figure 2.5 or mesh lattices in Figure 2.6 are designed knowing honeybees fill unwanted gaps with propolis (Crowder & Harrell, 2012).

Figure 2.5 (left): Removing propolis from metal trap (BeladAl-ShamApiary, 2010)

Figure 2.6 (right): Clean mesh propolis trap (Cane et al., 2014)

Once filled, the beekeeper can remove the trap and freeze or melt it to remove the desired raw propolis. Propolis is easily removed from the hive during a colder off-season, as it is an extremely sticky and viscous substance at a warmer temperature (Crowder & Harrell, 2012).

2.3.2 Propolis processing

There is no standardized method for processing raw propolis because the composition of each propolis sample and the desired form or concentration of the final product varies (Bankova, 2005). Also, the quality of a sample of raw propolis can greatly vary depending on where and how the hive is maintained as well as how the propolis is harvested (Krell, 1996). It might need to be cleaned and purified to discard dead bees, excessive wax and dirt before processing. There are different methods to clean raw propolis, some require soaking in water while others require soaking and heating (Bernard, 2014; Hogendoorn, Sommeijer, & Vredenbregt, 2013). Ideally the cleaning step is avoided by collecting high quality raw propolis from regularly cleaned traps. Soaking and heating propolis can cause important compounds to dissolve in the cleaning solution (Bernard, 2014). Some of the important compounds that make up propolis include many organic compounds, polyphenols, flavonoids, minerals, and proteins (Bogdanov, 2011). Each process to dissolve raw propolis focuses on retaining the desired compounds.

Depending on what form or concentration is needed for the final value added product, there are many different methods to process raw propolis (Krell, 1996). Most methods involve dissolving propolis in ethanol, but there are other procedures that involve using propylene glycol or oils as the solvent (Krell, 1996). In an effort to optimize this process, more organic solvents have been tested including ethyl acetate and benzene (Naik, Vaidya, & Behera, 2009). Each method has its advantages, disadvantages, and obstacles for beekeepers and creating propolis for products.

2.3.3 The uses of propolis

Many uses for propolis have been discovered over time. Currently, propolis is mainly used to create an extract which is sold in a tincture at varying concentrations as seen in Figure 2.7 (Krell, 1996).

Figure 2.7: Propolis Extract Tincture (Return2Health, n.d.)

However, propolis dissolved into a solution is also used as an ingredient in cosmetics, medicine, and natural preservatives (Krell, 1996). Studies have found that propolis' composition has characteristics including "antibacterial, antifungal, antiviral, anti-inflammatory, hepatoprotective, antioxidant, [and] antitumor" making it a more desired substance (Bankova, 2005). Components like flavonoids and minerals cause raw propolis to have these characteristics. Value added propolis products are used to treat conditions such as allergies, cancer, skin irritations, weakened immune systems, burns, and acne (Krell, 1996). While some medical uses are scientifically proven, other medical treatments are only hypothesized and practiced by individuals who believe it to successfully treat their needs.

2.4 Wax as a Value Added Product Ingredient

2.4.1 Wax and how it is harvested

Beeswax is made up of over 200 natural compounds and varies in composition by geographical location (Krell, 1996). Bees excrete eight milligrams of wax every twelve hours through wax glands on their abdomen, as shown in Figure 2.8 (Bradbear, 2009).

Figure 2.8: Wax Glands (Zimmerman, 2011)

Wax production depends on factors such as nectar flow, egg laying, temperature, and even bee species (Bogdanov, 2004). For example, Asian honeybees create wax that has a plastic consistency while African honeybees produce wax that is preferred for creating cosmetics (Krell, 1996). There are techniques that can increase production rates of beeswax such as using frameless hive structures and frequently changing the wax (Bogdanov, 2004). However, these hive maintenance improvements are uncommon as wax is often discarded during small-scale beekeeping (Bradbear, 2009). The amount of wax harvested in conventional Langstroth hives is small compared to the amount of honey; the extraction ratio of honey to beeswax is around 75:1 (Bradbear, 2009).

2.4.2 Wax processing

Before wax can be processed for advanced consumer products, it must be washed to remove honey and debris such as pollen and propolis (Krell, 1996). There are two types of wax extraction procedures that exist: chemical breakdown and melting (Bogdanov, 2004). The methods involving chemicals are uncommon among beekeepers and mostly done in small-scale lab production (Bogdanov, 2004). Melting procedures are commonly done by all beekeepers to purify wax. Melting can be done by boiling wax in water or in steam and then filtering it. A more energy efficient way involving the use of a solar wax melter exists such as the one shown in Figure 2.9 (Krell, 1996). The heat of the sun melts the beeswax with water in the solar melter so the debris sinks and the purified wax floats to the top (Crowder & Harrell, 2012).

Figure 2.9: Solar Wax Melter (Wheeler, 2012)

To avoid discoloration, wax should never be heated over 85°C and should not be treated in unprotected carbon steel, iron or copper containers (Krell, 1996). Cleaned wax must also be stored properly until needed for further use. For example, to avoid acaricide contamination, one of the most common beeswax contaminants, wax should be stored in cool, dry places (Bogdanov, 2004). Wax should only come in contact with non-toxic chemicals such as sulfur or acetic acid to treat against wax moths (Bogdanov, 2004). Proper processing and storing can create high quality wax for use in advanced value added products.

2.4.3 The uses of wax

Wax has many purposes dating as far back as the ancient Egyptians (Krell, 1996). Currently, beekeepers mainly use wax to create the basic structure of combs in frames, commonly referred to as foundation sheets (Bradbear, 2009). However, wax is also used as a component in many other products such as cosmetics, pharmaceuticals, candles, chewing gums and polishes (Bogdanov, 2004). Wax has a good consistency making it useful in cosmetics (Krell, 1996). Beeswax, in comparison to synthetics waxes such as paraffin, is considered a higher quality ingredient for candles as beeswax candles stand straighter and drip less (Krell, 1996). By world trade, 40% of beeswax is used for cosmetics and can be a profitable small scale endeavor (Bradbear, 2009). About 20% of traded wax is used for creating candles because of the traditional use of beeswax candles in religious ceremonies (Bogdanov, 2004). Wax related products provide an

additional income for beekeepers. Also, wax can be a source of income during the less profitable winter months (Crowder & Harrell, 2012).

2.5 Albanian Beekeeping

2.5.1 History and growth

Beekeeping has seen tremendous growth in Albania with hive numbers increasing by 287% between 2000 and 2010 (Dobi & Shehu, 2012). Illustrated in Figure 2.10, Albania has between three to five hives per square kilometer; a hive density equal to or higher than that of most of Europe (De la Rúa, Jaffé, Dall'Olio, Muñoz, & Serrano, 2009). The beekeeping sector has recently increased because of its liberation after the fall of communism (Dobi & Shehu, 2012).

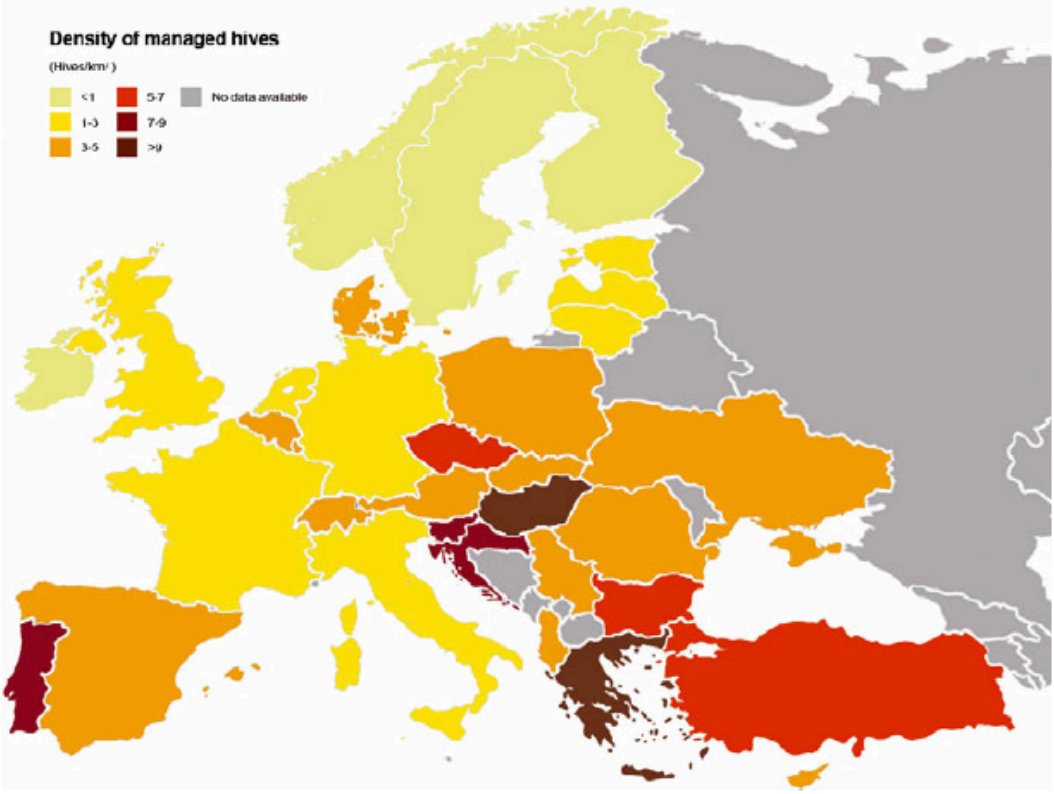


Figure 2.10: Europe's hive density (De la Rúa et al., 2009)

Although apiculture has been a vital and predominant part of Albania's rural economics for over 2000 years, currently hobbyists dominate the craft (Aguiar, 2008). Hobbyists, described as beekeepers with fewer than ten hives, own 63% of the hives in

Albania and should not be considered inexperienced (Dedej, 2000). 68% of beekeepers with fewer than ten hives have over a decade of experience (Dedej, 2000). This small individualistic approach to beekeeping as a business is the direct result of communism ending. People living in rural areas needed to supplement their incomes as their land plots were now smaller and often isolated (Hall, 1996). During communism, the beekeeping sector was controlled by the government and supported by specialized institutions (Dobi & Shehu, 2012). The fall of communism allowed beekeepers to create their own businesses. However, the lack of control and support from the government created gaps in the apiculture infrastructure such as a lack in specialized institutions, laboratories, and breeding programs (Dobi & Shehu, 2012).

2.5.2 Current production of hive products and value added products

The honeybee, or Apis mellifera, population has many different branches with their own origins and characteristics. The bees most often found in Albania are the C branch or specifically Carniolan bee (De la Rúa et al., 2009). Differing honeybee species do not affect quality of hive products collected within a region like Europe (Krell, 1996). In 2000, approximately 1200 beekeepers completed a questionnaire that was used to examine the apiculture industry in Albania (Dedej, 2000). Figure 2.11 represents the breakdown of income from three core products depending on apiary size. Small-scale beekeepers can focus on efficiently extracting wax as they have fewer total hives. Large-scale beekeepers do not always depend on wax for profit. They can produce higher quality products such as starter honeybee colonies called nuclei hives.

TABLE 2. Average incomes realized by Albanian beekeepers expressed as percentages from honey, wax and nuclei (Lek).

	No. honey bee colonies		
	1–10	11–30	30 +
Average number of colonies owned	6.4	19.5	49.6
Honey (%)	93.6	88.7	85.7
Wax (%)	6.4	1.2	1.9
Nuclei (%)	—	10.1	12.4
Total (%)	100	100	100

Figure 2.11: Profit by apiary size (Dedej, 2000)

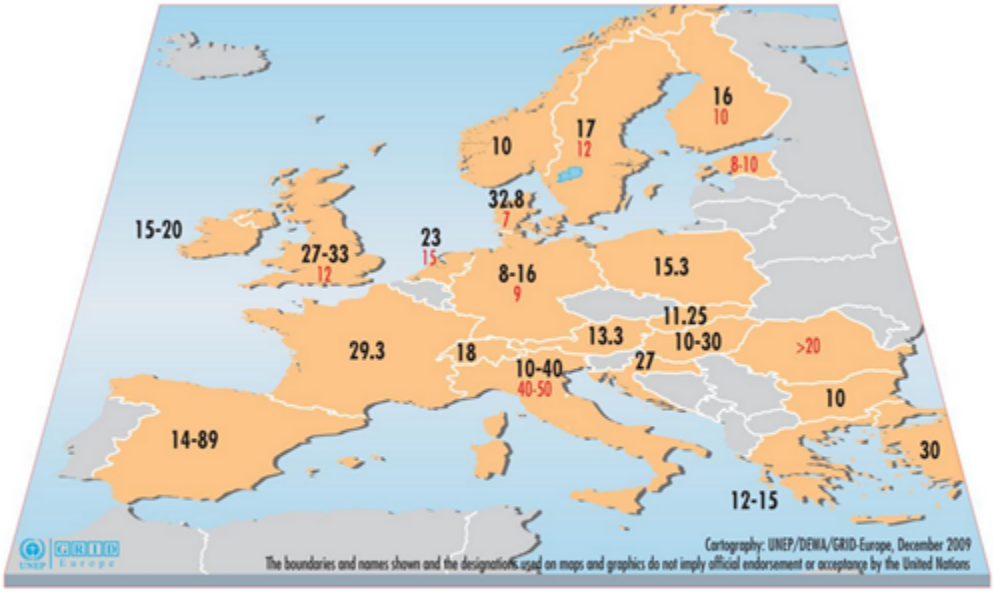
Beekeepers who actively maintain more than 10 hives can make $2000-$3000 per year from honey alone, a reasonable yearly income in Albania in 2000 (Dedej, 2000). However, beekeepers that make other products can supplement their earnings through creating a more diverse market. By producing royal jelly, propolis, candles, and beeswax cosmetics beekeepers can increase profitability in some situations by 50% (Dirina & Bugina, 2012). Many challenges resulted because of the unstructured development of the Albanian apiculture industry, causing advanced value added products to often be overlooked.

2.6 Challenges Facing Albanian Beekeepers

Albanian beekeepers face challenges improving the quality of their products and the efficiency of their processes. There are both biological and production challenges that beekeepers encounter in trying to improve the quality and methods of making their products. However, the solution to understanding and improving both areas is education.

2.6.1 Global honeybee issues relating to beekeeping Albania

The global beekeeping industry faces many environmental issues due to human actions. These challenges affect the industrial apiaries of large producers to the humble set ups of hobbyist beekeepers. The United States Department of Agriculture reported that US honey-producing colonies have dropped from a population of six million in the 1940s to 2.3 million in 2008 (Pettis & Delaplane, 2010). Although the declining honeybee population has always been a concern, the decline has increased dramatically in recent years. Starting in 2007, an unprecedented large decline in the honeybee population worldwide was reported (Pettis & Delaplane, 2010). In that year alone, countries across Europe reported losing more than 30% of colonies (De la Rúa et al., 2009). The United Nations environmental agency issued a warning, stating that the world honeybee population is likely to keep declining unless humans change the way they manage the planet (McCarthy, 2011). Figure 2.12 shows the increasing mortality rates for colonies in the European Union, which follows the worldwide trend.



Data for colony mortality in European countries remains scarce or uneven. The most recent data compiled by the COLOSS working group indicates that winter losses are common and the main pathogen during this season is Varroa destructor[15]*. Other factors such as pathogens*[16] *or pesticides*[17] *are also being studied.*
Source: In black 2007-2008 mortality (COLOSS, Zagreb meeting proceedings), in red 2006-2007 mortality (EFSA members poll)

Figure 2.12: European colony mortality statistics ("Partial Collapse," 2013)

Although the causes are not entirely known, experts believe that pesticides, parasites, and other invasive organisms play a role in the declining population (Cox-Foster et al., 2007). There is a new generation of chemicals called systemic pesticides which have been used in the US and Europe since the 1990s (Gross, 2011). Unlike other pesticides, which remain on the surface of the treated plant, systemic pesticides are absorbed into the tissues, pollen, and nectar of the plant (Hanley, 2014). This new treatment causes crop seeds to poison any insect that consumes them (Gross, 2011). Beekeepers have to be aware of the potentially damaging effects pesticides can have on a hive as chemical residues are stored in wax (McNeil & Frazier, 2014). An American study testing nearly 900 samples of wax found that 99% had detectable chemical residues and 60% contained at least one systemic pesticide (McNeil & Frazier, 2014). Chemicals compound year to year inside wax; if left unchecked chemicals can reach deadly levels and the hive can collapse (McNeil & Frazier, 2014).

Other issues that have an effect on colony health are diseases affecting the brood and mites such as the *Varroa Destructor* (Smith et al., 2013). The *Varroa*

Destructor has been observed to transmit pathogenic viruses such as Deformed Wing Virus and Acute Bee Paralysis Virus, both of which are known to contribute to widespread losses (Smith et al., 2013). These factors and contamination from pesticides have been correlated with the newer phenomenon called Colony Collapse Disorder (CCD) (Cox-Foster et al., 2007). CCD is described as the rapid loss of a colony's adult bee population and is a global concern having affected annual colony losses since 2007 (Smith et al., 2013). These diseases and conditions force beekeepers to prepare financially for potential hive losses and other impacts on their livelihoods

2.6.2 Educational challenges

Despite beekeeping being widespread, Albanian beekeepers often lack informative resources. In traditional farm households in Albania, the man is responsible for tending to mechanical systems such as tractors and irrigation while women clean, collect, and process agricultural products (Clarke, 1999). Only 11% of women in rural households have a high school education compared to nearly 18% of males (Clarke, 1999). As a result, typically the uneducated women in the family are in charge of the beekeeping marketing and practices. Recent training projects have focused on increasing women and youth participation in beekeeping education efforts (Zall Bastar, 2014). However, some communities continue to resist these efforts as women hold a lower role in society because of persistent gender inequality views from pre-communism social policies (Stecklov, Carletto, Azzarri, & Davis, 2010). Traditions and stagnant patterns in Albanian beekeeping will remain without women and youth beekeepers having the ability to learn more about apiculture. While existing Albanian beekeeping practices require minimal financial inputs, additional investments could improve the current situation (Dedej, 2000). By resisting change and exploring more innovative methods, beekeepers may hinder their ability to increase profits and sustain their livelihoods.

Without the beekeeping cooperatives under the communist government, Albanian beekeepers lacked successful communication and sharing of educational information (Dobi & Shehu, 2012). By working together beekeepers can distribute

important information and help individuals advance their businesses. The Albanian Beekeeping Association has been credited with reestablishing the honey and apiculture infrastructure, advising efficient procedures, creating market channels for beekeeping products, and setting up factories to produce related supplies (Aguiar, 2008). Currently, they spread education and awareness to beekeepers through local divisions, meetings, and publications (Dobi, 2014). However, the post communism mentality offers an additional challenge in terms of collaboration to improve sharing of information (Bregasi, 2013).

Beekeeping products are in high demand in Albania, especially with the reduction in the global honeybee population (Bröker, 2003). In the winter of 2011, Albanian colony loss was at 20% (Dobi & Shehu, 2012). In addition to the honey produced in the country, Albania imported $144,000 worth of honey in 2011 while exporting little to no honey (IndexMundi, 2014). A profitable market for beekeeping products is not taken advantage of in Albania as there is honey imported to meet customer demands. To keep a small-scale business set up profitable, some Albanian beekeepers sell their honey at higher prices to make the most profit per unit (Aguiar, 2008). Because of this situation, imported honey is sold at a lower cost, sometimes fraudulently labeled as Albanian honey (Aguiar, 2008). As of 2000, only 17% of beekeepers in Albania understood how to market their products in term of using proper packaging, advertising, and labeling (Dedej, 2000). Over time, the importance and practices of labeling have been addressed in Albania (Dobi, 2014). However, there are further areas of development in creating value added products from hive substances such as propolis and wax that can be demonstrated through educational resources.

2.6.3 Propolis production challenges

An ideal standard process is one that can be recreated and repeated in a timely and efficient manner. While beekeepers know the importance and potential uses of propolis, there are many challenges that still exist in standardizing the process of creating propolis extracts with known concentrations. One of the difficulties is the issue of varying chemical compositions between propolis samples (Bankova, 2005). Propolis

samples are assumed to have similar components if collected from areas with similar plants (Bankova, 2005). For example, Mediterranean propolis is distinguished from general European propolis for having a high amount of diterpenoids and thereby strong antibacterial characteristics (Popova et al., 2011). Without the technology to determine the composition of every compound in a propolis sample, it is challenging to standardize a process to make an extract of a known final concentration. An alternative to compound concentration is concentration by weight. A standard process to create and determine a propolis extract with a known concentration by weight can be conducted based on weight percent of total propolis dissolved in a known amount of solvent (Krell, 1996). If a propolis extract is intended for medicinal products, compound concentrations are important as different compounds are known to have different effects (Krell, 1996).

There is also the issue of which solvent is best to dissolve the propolis. The ideal solvent is safe for humans and capable of dissolving both the polar and nonpolar compounds found in raw propolis. For these reasons ethanol is the widely used solvent, but propylene glycol and oils are also used (Bogdanov, 2004). However, these solvents take an inefficient amount of time dissolve propolis (Dobi, 2014). Beekeepers take several weeks to a few months to complete this process. Beekeepers must decide which method and solvent is feasible and best depending on the final use of the propolis extract, available technology, and quality of raw propolis.

2.6.4 Production challenges of wax products

While wax can be sold for three times as much as honey in beekeeping businesses, raw wax can be processed into value added products such as candles and cosmetics for additional profit (Dirina & Bugina, 2012). When producing candles, beekeepers are often either limited to symmetrical shapes or have to purchase candle molds from international sources (Dobi, 2014). High quality candle molds, such as those in Figure 2.13, are often made from silicone rubber, a material not readily available to beekeepers in Albania.

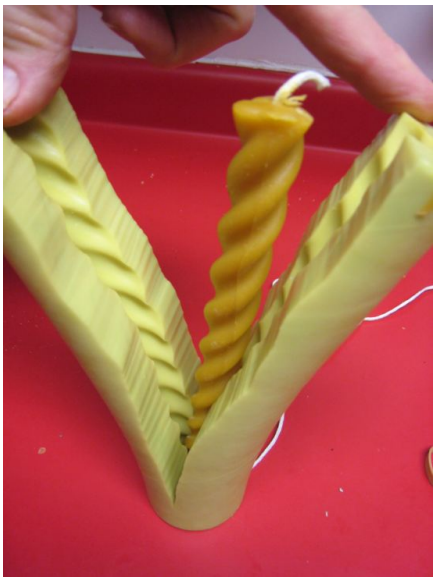


Figure 2.13: Rubber Silicone Molds (Shaw, 2013)

Cosmetics require clean, high quality wax to be used as an ingredient in face creams, skin ointments, and soaps (Krell, 1996). Proper wax cleaning procedures require education about suitable equipment and limitations surrounding heating and storage. This sort of education about techniques is lacking in Albania because the government run institutions regulating and researching beekeeping efforts were disbanded in the early 1990s (Dobi & Shehu, 2012). Many local beekeepers throw away extra beeswax because unprocessed wax is undesirable; however candles and cosmetics can be financially successful products made using wax (Bradbear, 2009). If beekeepers in Albania want to expand their endeavors and increase their revenue, they need information on how and why to produce value added products.

2.7 RASP

Albanian beekeepers want to improve their techniques and products. According to a 2008 survey, beekeepers want to focus on quality, flavor, organic production, packaging, and price (Aguiar, 2008). One organization that is working toward improving the situation of the beekeepers in Albania is RASP, the Rural Association Support Programme. RASP's missions is to "stimulate opportunities for rural people to improve their livelihoods and reduce poverty, by making best use of natural, cultural and human resources to achieve sustainable development" (RASP, 2013). This non-profit

organization, founded in February 1997 receives funding for its projects through grants, sponsors, and charities (Misha, 2014). RASP addresses various simultaneous projects determined on an as needed basis in which donors sponsor specific activities as problems and potential solutions arise (Dhëmbo, 2012). Recent projects include programs spreading awareness for human trafficking, promoting sustainable agricultural production, encouraging development of rural businesses through agrotourism, and reducing poverty through beekeeping associations (RASP, 2013). Petrit Dobi, executive director of RASP, has tasked our team with exploring how beekeepers in Albania could create value added products from hive materials. Our team focused on materials such as propolis and wax in order to demonstrate techniques or methods in educational resources that can be used to assist the growing apiculture industry.

3. Methodology

The goal of our project was to investigate current beekeeping practices in Albania and create educational resources that recommend feasible processes for producing profitable value added products for beekeepers to sustain their efforts. To achieve our goal, we established and completed the following objectives:

- Determining common Albanian beekeepers' practices
- Investigating methods for creating value added products
- Assessing the feasibility of selected value added products
- Creating sustainable educational resources for Albanian beekeepers

In this chapter, we elaborate on these objectives, discuss why they were important to our project goal, and provide explanations on how we accomplished them. We identified three value added products through collaboration with RASP, local beekeepers, and individuals working on relatable projects. Those products were not only found to be potentially profitable, but also determined to be feasible for Albanian beekeepers to manufacture. The three products included propolis tinctures, beeswax candles, and simple cosmetics. In addition, extensive research was conducted on how these products are made and created by beekeepers in other countries. Our team spent time testing methods and techniques to make these products. This enabled us to write informational pamphlets and guides.

Before arriving in Albania our team researched general beekeeping practices to learn about the craft. Specifically, we learned about harvesting raw hive materials, processing these materials, and creating consumer products to expand a beekeeper's businesses. We also contacted members of the Worcester County Beekeeping Association (WCBA). These connections allowed our team to experience beekeeping first hand, learn from the WCBA's bee exhibits, and gain insight from informative conversations with their representatives.

3.1 Determining Common Albanian Beekeepers' Practices

Our team researched beekeeping practices in Albania and recent advances in the beekeeping industry. To accomplish this, our team held various interviews upon arrival in Tirana with our liaison at RASP, individuals from local nongovernmental organizations, and local beekeepers.

Professor Petrit Dobi

During our meetings with our liaison, Professor Petrit (professors in Albania are addressed by their first name), we discussed our background research and our hands-on beekeeping experiences. We discussed our progress and our proposed methodology to direct our project towards what he envisioned us accomplishing. These meetings helped us determine and agree upon specific beekeeping products and processes in Albania that our project was going to address. It was reasonable to decide on these areas with the assistance of Professor Petrit as he has experience with beekeeping in Albania and understands the current issues surrounding beekeeping.

We also visited an apiary near the Tirana International Airport with Professor Petrit to compare beekeeping practices with what we had seen in the United States and researched. This allowed us to verify that Albanian beekeepers had comparable tools and technology.

Lindita Çeçja

Our team interviewed the executive director of the Association for Gender Integration, Lindita Çeçja. We spoke with her about common beekeeping practices in Albania and how she distributed educational resources, as her organization had conducted several beekeeping initiative projects. This information was useful and relevant in determining what kinds of educational resources our team should create and how to best distribute them. She brought along her two daughters to translate and our team member, Daniel, also helped translate during this interview. Our team followed a set of prepared questions, but this interview was rather informal and more conversational. The summary of this interview can be found in Appendix A.

Kujtim

Our team conducted an interview with Kujtim, a local beekeeper who also owns a café outside of the Universiteti Bujqesor I Tiranes (the Agricultural University of Tirana). He provided our group with reliable information on common beekeeping practices in Albania as he has had twenty hives for over ten years. We asked about the hive materials he collects and the methods he uses for harvesting them. We further discussed how he uses those substances to prepare products to sell. Professor Petrit helped us contact him and was present at the interview to act as our translator. The summary of this interview can be found in Appendix B.

Frida

We informally interviewed our local project coordinator, Frida as she is also the executive director of a local youth nongovernmental organization called Borderless. She is currently working on a project to make organic soaps as a fundraiser and offered to share what she has learned and accomplished. We asked her about what kind of materials and time constraints are necessary to create soaps. This allowed us to determine if soaps were a cosmetic product that we should consider pursuing as a value added product for beekeepers.

Sindi Dobi

Frida suggested talking to Sindi Dobi as she is a volunteer with Borderless who is working on a project to create candle molds to make candles to sell. She told us about what materials she used and where to get them. She accompanied us to help purchase some materials to make candle molds. She was also able to provide us with some insight as to the obstacles she had encountered and how she overcame them.

Lejla Shehu

We also interviewed Lejla Shehu, the head of the Albanian Beekeeping Association (ABA) since 1991 who maintains approximately 70 hives. We asked her questions about her beekeeping efforts, products she creates, her involvement with the ABA, and common obstacles other beekeepers face in making products. We had a

prepared set of questions ready to ask her and our team member, Daniel, was there to help translate during this interview. A summary of the interview can be found in Appendix C.

3.2 Investigating Methods for Creating Value Added Products

Beyond gaining valuable information through communicating with locals, our team researched efficient and practical techniques and procedures for dissolving propolis, crafting candle molds and candles, and creating cosmetics with beeswax. To accomplish this, we looked at methods used by experienced beekeepers in Albania and other countries. Many scholarly articles or reports discussed different ways to dissolve propolis to create propolis tinctures. However, personal blogs and websites described methods and practices to create candles and cosmetics as these processes are well developed. We compiled many methods that were both practical for beekeepers to do and for us to test through this research.

3.3 Assessing the Feasibility of Selected Value Added Products

We created the products ourselves in Tirana to explain and validate practical production processes. Our informational pamphlets and guides would include examples of the production methods, where we encountered problems, and how to overcome them. We tested many methods to make the selected value added products about which our team wanted to educate beekeepers. Before we tested the methods for making the products, our team located the necessary materials in Tirana.

3.3.1 Resources needed for product creations

We decided to use only resources available in Albania for the process of making these products to ensure our recommendations are available and affordable for Albanian beekeepers. We travelled to different shops and markets to find materials for our propolis, candle, and cosmetic tests. Our team faced challenges in locating specific materials, as many stores did not have websites with online inventories. We discussed where to locate materials with locals. On several occasions, Sindi, Frida, and Lejla helped us locate materials.

3.3.2 Propolis dissolving lab experiment

Currently there is little knowledge among Albanian beekeepers of other solvents that can be used besides the safe, yet inefficient ethanol. Due to this, Professor Petrit tasked us to find an efficient method to dissolve propolis. Professor Petrit arranged for our team to have lab space for our experiments at the Universiteti Bujqesor I Tiranes (Agricultural University of Tirana) where he teaches. We tested a variety of solvents to propose an alternate method to dissolve raw propolis in a shorter time. We designed a two-part experiment accounting for both scientific and practical perspectives of this process. Our formal lab report with our complete procedures and results can be found in Appendix D.

The first part of our experiment tested concentrated chemical solvents to dissolve raw propolis to determine effective dissolving characteristics. We decided to use ethanol, diethyl ether, acetic acid and acetone based on research of solvents previously tested and investigating safety concerns about those chemicals. We focused on creating propolis solutions with concentrations by weight rather than the concentration of components of the propolis in solution. The sample of raw propolis was frozen and broken up into smaller pieces using a mortar and pestle. Propolis samples of 4.0 grams were added to 20mL of ethanol, diethyl ether, acetic acid and acetone. These solutions were mixed twice a day for the following week and observations recorded. The solutions were filtered using a chiffon material. The undissolved propolis in each solution was weighed.

The second part of our experiment focused on using available and affordable solvents. We grated frozen propolis into a fine powder to maximize the surface area in each solution. Since strongly nonpolar solvents work best at dissolving the wax in propolis, we selected extra virgin olive oil as the nonpolar solvent in this experiment. To best dissolve the polar compounds in propolis such as resins, we selected to compare two solvents, commonly used 96% ethanol and *raki*, a more available source of ethanol in Albania. We created three control solutions consisting of 4.0 grams of propolis in 20mL of ethanol, olive oil, and *raki.* These acted as baseline measurements for

reference. We also created solutions with two phase solvents, one nonpolar, olive oil, and the other polar, either ethanol or *raki.* We focused on determining if a mixture of a polar and nonpolar phase efficiently dissolved propolis. We mixed varying amounts of ethanol and olive oil to investigate if different volumes of the polar and nonpolar phases would have an effect on the dissolving process. These solutions always had a total volume of 20mL and also contained 4.0 grams of propolis. They were as follows: 5m ethanol with 15mL olive oil, 10mL ethanol with 10mL olive oil, and 15mL ethanol and 5mL olive oil. To determine if the order of solvents mattered, we tested two scenarios: one when 4.0 grams of propolis was first dissolved in 10mL of ethanol and later an additional 10mL of olive oil was added, and the other when 4.0 grams of propolis was dissolved in 10mL olive oil and then 10mL of ethanol was added. The final mixture was a 10mL *raki* with 10mL olive oil mixture with 4.0 grams of propolis.

These solutions were mixed twice a day for the following two weeks and observations were recorded. The nine solutions were filtered using *frazelinë,* a thin cotton and polyester material. The raw undissolved propolis in each solution was rinsed with water, given overnight to dry, and weighed.

3.3.3 Candle samples

Our team used local materials and different methods to create candles and candle molds. We determined which processes were successful and possible for beekeepers in Albania to replicate. We tested ways to easily clean raw beeswax, color candles with assorted materials, create candles without molds and construct candles with more complex molds.

We tested techniques and methods for cleaning wax, such as a gravity settling method and a filtering method. As wax's color indicates debris content, we compared the color before and after each cleaning technique. The lighter the wax was compared to the original sample, the cleaner it was. We also looked at the accessibility of materials as well as the amount of time and difficulty of the methods.

We also experimented with coloring wax for candles. We tested the feasibility of using different materials to color beeswax. We used herbs as an all-natural dying

material. We varied the quantity of materials used and methods of mixing to determine the most efficient, yet effective coloring beeswax procedure. Due to a limited amount of beeswax, we only made small samples. We tested some possible herbs and therefore only a small spectrum of color possibilities.

We determined specific methods for making candles without molds. Although these candles are not elaborate, our goal was to provide instructions for beekeepers of varying experiences, including beginners. We tested methods for making tapered candles, rolled candles, and jar candles. From various sources online we determined what materials and which processes to test. Due to limited supplies, we only made small samples. Making larger candles may require a different ratio of materials or time to cool. We recorded the dimensions of our candles for beekeepers to predict supplies for bigger projects.

In Albania, more elaborate molds are often bought from other countries, such as the UK. The ability to make their own molds allows beekeepers to make creative and personalized products. We tested three types of molds; hard two piece molds, flexible synthetics molds, and paper molds. We tested various materials to create a hard mold. We also looked into the accessibility of materials and equipment to make more elaborate 3D printed molds. For flexible molds, we casted a candle template shape in one material. We also repeatedly dipped a candle template in an alternative material. We compared these methods in terms of stability, costs, and difficulty to make. Candle templates made of different materials were used to determine what materials worked for each mold type. We tested the durability of the paper mold in terms of leakage. Because of a limited amount of wax, we had difficulty testing each mold thoroughly. However, each mold making method was tested multiple times to ensure practicality. We partnered with Sindi, a representative of the nongovernmental organization Borderless, to share resources as she was working on a project making candle molds.

3.3.4 Simple cosmetic samples

There are many recipes and methods for making simple and advanced wax based cosmetics. Some cosmetics require many ingredients and multistep processes to create because of their different components. We tested simple cosmetic recipes to produce a lip balm, cold cream, and moisturizing lotion. We focused on three cosmetics to provide beekeepers with a variety to create. The cost of the materials purchased was recorded to determine if these products were feasible for beekeepers in Albania. Each cosmetic required different procedures and ingredients to make; however, all required beeswax. We melted the wax using a double boiler set up and cleaned the wax using a gravity settling method. That process was repeated several times to obtain the cleanest wax possible.

The lip balm required three ingredients and a single step to produce. A detailed recipe can be found in the cosmetic recipes in Appendix F. We melted clean beeswax and mixed in the almond oil. Once the mixture was consistent we removed it from the double boiler to cool and mixed in the vitamin E capsule. We placed the finished lip balm into a glass jar container for storage.

The cold cream required four ingredients and a multistep production process to create. A detailed recipe can be found in Appendix F. The oil based ingredients, clean beeswax and olive oil, were melted in a double boiler and mixed together. The water portion was warmed in a separate pot and mixed into the pot of the melted oil based ingredients. Once the mixture was consistent, we removed it from the double boiler to cool. While cooling a vitamin E capsule was split open and mixed into the solution. The final product was poured in a glass jar for storage.

The moisturizing lotion required six ingredients, but was made using the same steps as the cold cream. A detailed recipe can be found in Appendix F. We melted and mixed the oil based ingredients consisting of almond oil, coconut oil and beeswax in a double boiler. When completely mixed, the oil based ingredients were removed from the double boiler to cool. The water based ingredients, which consisted of water and

aloe vera, were measured and gradually mixed into to the cooling mixture. We stirred the ingredients together for five to ten minutes to ensure a consistent mixture.

3.4 Creating Sustainable Educational Resources for Beekeepers

We made RASP and Professor Petrit educational pamphlets and guides from the information we determined about these value added products. We created pamphlets for printing and to upload online. We condensed the information so beekeepers can learn a new process or refine an existing process. We provided more detailed information with steps to follow in instructional guides. The pamphlets concisely displayed basic information about the product processes whereas the guides would provide a more in depth explanation with steps from start to finish for processing final products. Also included in these resources were locations in Tirana where a beekeeper could find materials. The helpfulness of these final resources was confirmed by showing drafts to Lejla Shehu and Professor Petrit to gain feedback. We translated the pamphlets into Albanian with the help of a local translator. We saved our documents in several formats to easily upload them to RASP's website and extension services. In addition we printed some for distribution by RASP and The Albania Beekeeping Association. These distribution tactics will allow for the pamphlets and guides to successfully reach Albanian beekeepers.

4. Results

This chapter contains the results we collected from our interviews and experiments testing propolis and wax. We organized this chapter based on findings for each value added product. The organization of this chapter mirrors the steps from our methodology. Each section starts with information gained through our interviews. Next, important findings from our more in-depth research are reported. Then the results of our experiments and tests to create the value added products are explained and the results are discussed. We compiled and condensed our results into pamphlets and guides, which are located in Appendices G through L. This chapter also serves as a basis for the recommendations presented in the next chapter.

4.1 Propolis

4.1.1 Albanian beekeepers' practices regarding propolis

Professor Petrit Dobi

Professor Petrit has experience with propolis as he was a beekeeper, had completed research on honeybees, and was involved with beekeeping projects through RASP. He informed our team how some beekeepers currently use mesh traps to collect propolis while others just scrape it from the hives. However, he said scraping propolis from the walls of the hive can result in samples with higher amounts of wax, dirt, or other undesired residues.

Professor Petrit also explained that there is no standardized process to dissolve propolis. He said most Albanian beekeepers add propolis to alcohol and let it dissolve for an extended period of time. Some beekeepers might dissolve it for only a week or two while others might dissolve it for a month or longer. He mentioned that beekeepers primarily use ethanol as the solvent to dissolve propolis. While it takes a long time to dissolve propolis, ethanol is safe for humans to ingest and apply on their skin. Professor Petrit knew there had been research regarding using other chemical solvents to dissolve propolis efficiently. He asked us to investigate another viable option for Albanian beekeepers to pursue.

Kutjim

Kutjim has been beekeeping for ten years and maintains 20 hives. He told us during our interview that he collects many substances from his hives including propolis. He only uses propolis from a trap because he considers that method to yield the cleanest propolis. He described his process for dissolving propolis. He grinds 400 grams of propolis into a powder, adds it to one liter of 96% ethanol for 40 days, filters it several times, and evaporates some of the ethanol to make a tincture. The main limitation with this method is the time it takes to dissolve the propolis into the ethanol solution.

Lejla Shehu

We interviewed Lejla Shehu about how propolis is handled in Albania. Lejla has been the head of the Albanian Beekeeping Association since 1991 and personally maintains approximately 70 hives. She showed us two ways to test the quality of propolis from lab procedures published in Albania during the late 1980s. However, she explained that beekeepers do not know these tests exist. She further discussed how most Albanian beekeepers dissolve propolis with ethanol, but some know that propylene glycol or oils can be used. She also mentioned if beekeepers cannot obtain ethanol some use *raki*, an Albanian alcoholic beverage, because of its high alcohol content.

She stressed how propolis is a growing interest among Albanian beekeepers. Beekeepers know the important health benefits of propolis, but they face limitations in creating tinctures to sell both on a large and small scale. A certification verifying a process and product is required to export or sell in stores. The certification is challenging and expensive to obtain from the government. Therefore most Albanian beekeepers sell their tinctures to customers who trust them or at local markets and fairs. Lejla mentioned beekeepers with a reputation for making high quality products can locally sell propolis tinctures at a higher cost. However, beekeepers who have not yet established a good local reputation face limitations.

4.1.2 Methods for creating propolis solutions

The first challenge addressed in our interviews and background research was the determination of the quality and composition of raw propolis. After collecting raw propolis from the hive there are a couple ways to test the composition quality. Lejla presented one test involving heating and cooling an ethanol propolis solution to determine the amount of wax, undesired residues and resins in the sample (Tabllo & Orgocka, 1986). This test is in Albanian and can be viewed in Appendix E.

The next challenge is the issue of trying to dissolve propolis faster. The main ways to dissolve something faster are to heat it, increase the surface area of what is being dissolved, or change the dissolving solvent. Heating propolis should be avoided as that can destroy some of the desired compounds that make up the resins in propolis (Bogdanov, 2011). Our team focused on maximizing the surface area and looking for alternative solvents to dissolve raw propolis more quickly. We found propolis is commonly dissolved in ethanol, propylene glycol, and olive oil but these solvents take time. Alternative solvents have been used to dissolve propolis in other experiments. We found propolis had been tested in solutions such as diethyl ether, benzene, acetone, acetic acid, coconut oil, and ethyl acetate (Bogdanov, 2011; Naik et al., 2009; Pujirahayu, Ritonga, & Uslinawaty, 2014).

Our team tested how propolis dissolved in ethanol, diethyl ether, acetone, and acetic acid because of availability and potential uses in consumer products. Ethanol is commonly used despite its slight volatility and flammability, as it has been proven safe to ingest as most alcoholic beverages contain ethanol ("Ethanol," n.d.). Diethyl ether is a highly volatile, flammable solvent that has previously been used as an inhalant for anesthetic purposes ("Ether," n.d.). Acetone is also a volatile, flammable solvent, but is used in some cleaning products ("Acetone," n.d.). Lastly, acetic acid is also a flammable liquid that at lower concentrations, commonly known as vinegar, can be consumed by humans ("Acetic Acid," n.d.).

4.1.3 Laboratory experiments for processing propolis

To determine if there is a more efficient way for beekeepers to dissolve propolis, our team completed a multipart lab experiment. The purpose of this experiment was to overcome the challenges of processing propolis and to find ways to make this process efficient from a scientific and realistic perspective. While there might be a solvent or process that dissolves propolis efficiently, if it is not safe, available, or affordable Albanian beekeepers will not use that new solvent or process.

Lab Part One: scientific experiment results

Our team dissolved equal amounts of propolis in equivalent volumes of each of ethanol, acetone, acetic acid, and diethyl ether. This experiment revealed many results about the process of dissolving raw propolis. Although maximizing surface area is an important factor in increasing how quickly something dissolves, we found raw propolis was difficult to break down into smaller pieces. In trying to increase the surface area, we froze the raw propolis before grinding it with a mortar and pestle. This technique proved challenging as propolis thaws quickly. When not frozen its sticky consistency make it impossible to grind into a powder as it stuck to the mortar and pestle seen in Figure 4.1.

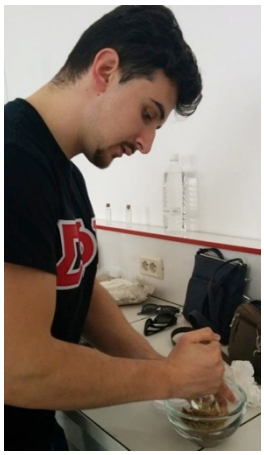


Figure 4.1(left): Grinding propolis with a mortar and pestle (Cane et al., 2014)

Figure 4.2 (right): 4.0 gram samples of small propolis pieces (Cane et al., 2014)

Instead, our team broke up the propolis into smaller pieces by hand shown in Figure 4.2. This was not ideal for our dissolving process, as the maximum surface area was not

achieved. We placed propolis into the solvents, as seen in Table 4.1, and some observations were immediately visible. The ethanol solution did not show any immediate change, the diethyl ether solution showed considerable dissolving discoloration, the acetone solution showed slight dissolving discoloration, and the acetic acid solution showed slightly less dissolving discoloration.

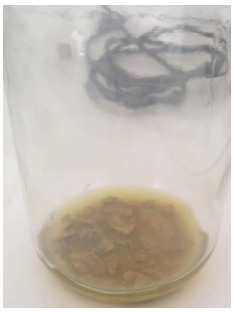
Solutions Immediately after propolis was added			
Ethanol	Diethyl ether	Acetone	Acetic Acid
			

Table 4.1: Immediate observations of propolis solutions

While stirring the solutions twice a day for the next week, our team noticed how the different solutions were dissolving the propolis. The ethanol solution was the slowest at dissolving the propolis while the diethyl ether was the fastest. Diethyl ether nearly dissolved all of the propolis completely by day three, however, the consistency of the diethyl ether solution at the end of the week was a paste because it evaporated. The acetic acid solution appeared to be dissolving it slightly better than the ethanol. The acetone solution was dissolving the propolis less quickly than the diethyl ether, but more than the acetic acid and ethanol solutions. The unfiltered solutions are shown in Table 4.2. At the end of the week the solutions were filtered using chiffon, a thin mesh-like material seen in Figure 4.3.

Solutions at the end of the week			
Ethanol	Diethyl ether	Acetone	Acetic Acid
			

Table 4.2: Unfiltered final solutions

Figure 4.3: Layered chiffon filters (Cane et al., 2014)

The chiffon filter with propolis was weighed, cleaned and weighed again. This should have allowed for the amount of propolis that did not dissolve in each solution to be determined. However, the final weights of the undissolved propolis were inaccurate because the liquid in the mesh filters and undissolved propolis did not have enough time to dry. Which solution dissolved the most propolis was determined based on observing how much propolis remained once filtered from each solution as seen in Table 4.3.

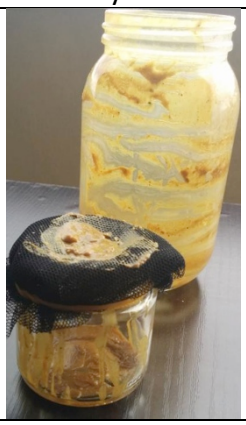
Leftover propolis from each solution that did not dissolve			
Ethanol	Diethyl ether	Acetone	Acetic Acid
			

Table 4.3: Filtered final solutions

This experiment revealed that diethyl ether is most efficient, then acetone, acetic acid and finally ethanol is least efficient in dissolving raw propolis. These results

show certain chemical properties that are better at dissolving propolis. Diethyl ether has nonpolar and polar characteristics as it has a symmetrical structure and dipole forces because of free electrons. Therefore diethyl ether can dissolve nonpolar wax and polar resins that make up propolis more easily than ethanol, a polar solvent. Regardless, ethanol remains the safest solvent to dissolve raw propolis. The safety concerns and ability to use diethyl ether and acetone in propolis products is still unknown and needs to be investigated. The result of this experiment shows the possibility that a mixture of a nonpolar solvent and a polar solvent might be an efficient, yet safe way to dissolve raw propolis.

Lab Part Two: practical experiment results

From the first experiment's findings, we decided to test mixtures of polar and nonpolar solvents that are safe for humans to ingest. The propolis for this experiment was grated rather than grinded. This allowed us to successfully increase the surface area by creating a fine powder, but it took time and effort to do so. The solutions that we created, using readily available solvents, with initial and final observations are listed in Table 4.4.

Solution	Initial Solution	Final Solution	Observations
Olive Oil (control)			Initial: Propolis sank in solution. Could not see color change as oil has tinted color. Final: Still had significant amount of solid propolis. The color was lighter than ethanol.
Raki (control)			Initial: After some time slight color change occurred after propolis was added. Final: Still had significant amount of solid propolis. The color was significantly lighter than ethanol.

Ethanol (control)			Initial: Compared to *raki* and olive oil solutions, showed the most immediate color change. Took time for propolis to sink into solution. Final: Had the most viscous consistency and darkest color. Significantly less solid propolis than *raki* and olive oil solutions.
Ethanol and Olive Oil (1:1)			Initial: The olive oil was above the ethanol and the propolis was suspended between them. Final: Compared to ethanol control solution: Color appeared as dark, was less viscous and had similar amount of solid propolis compared to ethanol.
Ethanol first, then olive oil (1:1)			Initial: Same as ethanol control solution observations. Midweek: When olive oil was added to ethanol, the propolis appeared to stay in the ethanol with the olive oil resting above. Final: Slightly less dark than Ethanol and Olive Oil (1:1) solution.
Olive Oil first, then ethanol (1:1)			Initial: Same as olive oil control solution observations. Midweek: When ethanol was added to the olive oil, the propolis appeared to lay in-between the two solvents Final: Slightly less dark than Ethanol and Olive Oil (1:1) solution.
Ethanol and Olive oil (3:1)			Initial: The olive oil was above the ethanol and the propolis was suspended between them. Final: Had more solid propolis than Ethanol and Olive Oil (1:1) solution.

Ethanol and Olive Oil (1:3)			Initial: The olive oil was above the ethanol and the propolis was suspended between them. Final: Had more solid propolis that Ethanol and Olive Oil (3:1) solution.
Olive Oil and *Raki* (1:1)			Initial: The olive oil was above the *raki* and the propolis was suspended between them. Final: Propolis seemed to settle in *raki* below olive oil. Was a darker color than *raki* control solution. Had as much solid propolis left as *raki* control solution.

Table 4.4: Images and observations of solutions from lab part two

After two weeks the solutions were filtered successfully using one layer of *frazelinë* rather than eight layers of chiffon. This material had a finer weave and is commonly used for filtering or lining clothes. We observed that each solution still had undissolved propolis. The straining time was prolonged, but it allowed for a better filtration and complete removal of raw propolis that did not dissolve. What was collected in the filter was rinsed with water and allowed to dry. This allowed for the amount of propolis that did not dissolve in each solution to be weighed and recorded in Table 4.5 to be compared.

Solution (20mL) with 4 grams propolis	Weights of undissolved propolis (grams)
Olive Oil	4.1
Raki 80 Proof	4.1
Ethanol 96%	2.2
Ethanol (10mL) and Olive Oil (10mL)	2.4
Ethanol (10mL) then later Olive Oil (10mL)	3.7
Olive oil (10mL) then later Ethanol (10mL)	3.5
Ethanol (15mL) and Olive Oil (5mL)	3.4
Ethanol (5mL) and Olive Oil (15mL)	4.5
Raki (10mL) and Olive Oil (10mL)	4.5

Table 4.5: Final weights of filtered propolis for every solution

The comparative weights in Table 4.5 do not indicate the exact weights of undissolved propolis in each solution. The exact weights could not be obtained, as the

liquid in the undissolved propolis did not dry completely dry before weighing. That is why some of the weights exceed 4.0 grams, which is how much propolis was originally added to each solution. However, these numbers can be used to compare to one and other, as the same filtering, rinsing, and drying methods were used. These results indicate that the ethanol solution and the ethanol and olive oil (1:1) solution dissolved propolis at practically the same rate and much faster than the other solutions.

4. 2 Candles

4.2.1 Albanian beekeepers' practices regarding candles

Professor Petrit Dobi

Professor Petrit explained some of the limitations that beekeepers in Albania face when creating candles from beeswax, specifically more elaborate colored and shaped candles. He told us beekeepers commonly use candle molds bought from different countries such as the United Kingdom. He explained how they do not usually make molds because the materials for molds are hard to locate and if found the packaging often lacks detailed instructions. He also indicated that making colored candles is another process about which beekeepers are not always knowledgeable.

Sindi Dobi

Sindi Dobi had experience making candles and was looking to make candle molds for a fundraiser for Borderless, an organization for which she volunteers. She had purchased some molds from another country that were made of a sturdy rubber material. For making molds, she told us she uses a reliable, silicone material. She searched for several months to find the correct material at a hardware supply store in Tirana. This material cost approximately 8000 Lek (70 USD) per kilogram. She indicated her problem was not that she did not have access to the material or knowledge, but that she did not have adequate candle templates for candles.

Lelja Shehu

Lelja Shehu confirmed that many beekeepers purchase their molds from outside Albania. However, she indicated that beekeepers often purchase molds and then proceed to make their own based on their example mold. This procedure shows beekeepers are unfamiliar with the process to make molds. Providing information about how to make molds properly would enable beekeepers to apply these processes without having to buy molds from other countries.

4.2.2 Methods for creating candles and molds

Cleaning methods

After wax is retrieved from the hive, it must be cleaned to remove unwanted debris. There are multiple methods for purifying wax depending on the sample size, the quality required, and the resources available (Hurley, n.d.). One way is heating wax and pouring it through filter material such as cheesecloth. This is an inexpensive method that is difficult as wax hardens quickly on the filter. Another inexpensive way is a gravity settling method after melting wax in a double boiler (Green, 2012). This process involves putting wax into a smaller pot over a large pot of boiling water. Once melted, the wax can be poured into a separate container where the dirt will gradually sink to the bottom of the wax. This process can be repeated to further clean the sample once the debris is cut from the bottom of the solidified wax. Some methods involved melting the wax with water to help with the collection of debris. This method can only process the amount of wax that can fit in the top portion of the double boiler.

Coloring methods

Colored candles can be more appealing and profitable. There are many types of commercial dyes that can be bought to color beeswax (Cattermole, 2013). Crayons can also provide color. These dyes are added while melting wax (WikiHow, n.d.). Herbs and spices are a natural coloring material (Pence, 2010). Beekeepers can place herbs or spices in a tea bag and add to hot liquid wax for coloring to occur.

Simple candles

Not all beekeepers harvest wax to make candles. We searched for ways beginners without experience could make simple candles. The most common way is making tapered candles by dipping cotton string, or the wick, into hot wax approximately ten times or until it becomes thick enough (Fisher, n.d.-a). To speed up the process the candle can be dipped in cold water after being dipped in wax. Beyond wax and string, this process requires a container to hold the melted wax that is tall enough for the desired candle. Rolled candles are another simple candle that are basic to make (Fisher, n.d.-b). The process involves rolling thin layers of smooth or textured wax around a wick to form a candle. Some beekeepers also make candles by pouring melted wax into a jar with a wick (Stoakley, 2014). This process requires beekeepers to have clean jars to hold the candles.

Type of molds

Molds are used to create more elaborate candles. It is common to purchase high quality molds from other countries. High quality molds can cost between 20 to 50 USD not including shipping (Thorne, 2014). For beekeepers to be self-sustaining they should be able to make inexpensive, yet personalized candle molds using local materials.

Hard two-piece molds are one type that are commonly made with materials like plaster or plaster of Paris (Armorlord, 2013). The candle template can be placed in a container with the bottom half encased in clay. The plaster is poured over the top. When the plaster hardens, the material is flipped upside down and more plaster is poured to fill where the clay was present. This process requires a ceramic type plaster material, a type of clay, a container to hold the mold, and a template for the candle shape. An advanced process to make a two piece mold can be done using a 3D printer (Alxpril, 2013). This process is more high tech and requires access to either software to design a candle mold or a design from online blueprint libraries. The materials needed are a design, a 3D printer, and the printing material.

Many high quality flexible molds are made of silicone rubber. This material is often sold commercially in two parts. One of the parts is the silicone rubber and the

other is a catalyst to solidify it. When the two parts are mixed, they can be poured into a container around a candle template (Smooth-On, 2011). The material will solidify and the candle template can be removed, leaving negative space into which hot wax can be poured. This process requires the silicone rubber materials, a container to let the mold harden, and a template for the candle shape.

Very inexpensive molds can also be made that they are not reusable. Paper molds are unconventional but can be used once to make interesting geometric candles (Degraeve, 2013). This process involves cutting and gluing paper into a candle mold shell. The only materials required are paper, scissors and glue.

4.2.3. Feasibility of creating candles and molds

Where to find necessary materials in Albania

We searched for materials to determine available materials for making molds and candles. Our group bought wax from a beekeeper at Pazar I Ri (an open air market). We found containers for melting and cleaning wax in general kitchen stores. Coloring materials were found in small food markets. A fabric store had materials for filtering. We found supplies for making molds at hardware and building supply stores. However, the identification of these materials was challenging. Albanian stores do not always label their materials and often sell items in unlabeled bags and cans. It was also difficult to find materials such as string and plaster of Paris as stores in the center of Tirana. Although we were able to find string in Megatek, a large hardware store. Some of these methods might not be feasible for people in rural Albania without easy access to shops and markets. We looked for alternative materials that were affordable and readily available in Albania to the materials online sources suggested. However, when we spoke to employees about what we were trying to create, they often scoffed at our ideas of trying alternative materials.

Cleaning

We determined an easy way to clean dirt and propolis from wax through testing several methods. We melted wax using a double boiler method. This set up heats a material in a smaller pot over a larger pot of boiling water. We tried using the steam from boiling water to melt the wax to prevent discoloration from overheating, as illustrated in Figure 4.4. However, this process took too long to melt the wax. We tried submerging half the small pot in the boiling water, which was successful in melting the wax. To clean the melted wax we filtered it through chiffon fabric into a plastic container and placed it in the freezer. The filtering process was difficult to clean and reuse. Furthermore, the wax was still dirty because using the freezer did not allow the dirt to settle at the bottom of the wax.

Another attempt included putting both water and wax in the small pot and heating it in the larger pot of boiling water. When the wax melted, we left the smaller pot to the side and allowed it to cool. The water and cooling time appeared to help the dirt settle to the bottom as seen in Figure 4.5. However, by leaving it in the metal pot, the wax was challenging to remove. After melting wax via the same processed, we poured the wax into a plastic container to cool. This method still allowed the dirt to settle and made removing the wax easier. We also determined that melting wax samples twice allows for cleaner wax as seen in Figure 4.6. During this process, we learned anything used in the wax melting process such as pots, silverware, and containers should all be specifically for wax usage as they are difficult to clean. However they can be reused in the same steps of wax processing repeatedly. We used plastic food packaging whenever possible for the cooling process to save money and avoid dirtying kitchenware.



Figure 4.4 (left): Double boiler with wax (Cane et al.)

Figure 4.5 (middle): Debris on bottom of wax that had cooled (Cane et al.)

Figure 4.6 (right): Lighter and darker wax (Cane et al.)

Coloring

We also colored wax during the melting process. While new and clean wax is a pale white or cream color, older and not cleaned wax is a yellow to brown color. As a result of our cleaning, our wax lightened in color as seen in Figure 4.7. We colored small samples of our clean beeswax using local spices and herbs. We put one tablespoon of paprika it in a tea bag, as seen in Figure 4.8, and added it to melted wax.


Figure 4.7 (left): Clean wax (Cane et al.)

Figure 4.8 (right): Tea bag with paprika (Cane et al.)

Our goal was to obtain a red hue from the paprika. We left the pouch in the wax for an hour, which yielded a wax that was a burnt orange shade as seen on the left in Figure 4.9. The cloudy white material on the top of the wax was unrelated to the coloring method. The white was aerated wax from stirring immediately before pouring it into a container. This process took a long time. We tried the same process with parsley in the hopes of obtaining a green shade; however, there was no noticeable change in the color of the wax. We tried using paprika again but this time pouring it in the wax to

speed up the process. After 30 minutes, we allowed the wax to cool and the solid remaining herbs to settle to the bottom of the wax. This process used less material and was easier to accomplish the shade of wax as seen on the right in Figure 4.9.

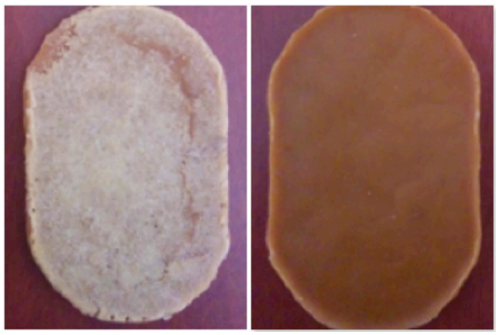


Figure 4.9: Aerated (left) and normal (right) paprika colored wax (Cane et al.)

Candles without molds

With clean, melted wax either plain or dyed, we made simple candles. We made taper candles through the dipping method. Due to the height of our containers, we made short candles rather than traditional tall candles. We used a weight at the end of the cotton wick, as seen in Figure 4.10, and dipped it 15 times until it was approximately two centimeters in diameter at the bottom. We dipped the candles in cold water between each dip to speed up the process. The process took approximately 10 minutes with only seconds between dips. The resulting candle can be seen in Figure 4.11. A disadvantage of this process is wasting the wax that built up on the weight. We successfully made a second tapered candle without using a weight. Instead, we straightened the wick by hand after the second dip while it was still pliable.

Figure 4.10 (left): Wick with weight (Cane et al.)

Figure 4.11 (right): Tapered candle (Cane et al.)

We also created rolled candles. While these are usually made with a textured foundation sheet material, we made smooth rolled candles. We poured a thin layer of wax into a small container to cool. The wax was easily removed and rolled around a wick to make the candle seen in Figure 4.12. We also tested a jar candle. We secured the wick in a vertical position while pouring in the melted wax as shown in Figure 4.13.

Figure 4.12 (left): Rolled thin layer candle (Cane et al.)

Figure 4.13 (right): Jar candle (Cane et al.)

Hard two piece molds

We tested making a hard two-piece mold using a material in Albanian called *llaç.* Plaster was not be tested because we could not find it in reasonably priced quantities. *Llaç* was later determined to be equivalent to mortar. We filled a container halfway with clay, put the candle template, and used olive oil to create a thin lubricant layer as seen in Figure 4.14. We poured the *llaç* paste, which was two parts *llaç* powder and one-part water, into the container. We removed it one day later and found it was solidified but brittle and fell apart easily as seen in Figure 4.15.

Figure 4.14 (left): Clay used in llac mold (Cane et al.)

Figure 4.15 (right): Brittle llac mold (Cane et al.)

Flexible one piece molds

A synthetic silicone rubber is the most common material to make high quality candle molds. Sindi Dobi gave us the silicone rubber and catalyst material, which she purchased at a local hardware materials store. With this material we tried making a basic candle mold with a clay star as seen in Figure 4.16. We poured it into a flat container and let the mold set for a week. However, it did not solidify and we determined that not enough catalyst was added. We made a second mold with a higher ratio of catalyst and it hardened in about one day, as seen in Figure 4.17. Because this material was expensive, we searched for alternatives. We tried using a silicone sealant and applying it around a bell mold. This material was unsuccessful, as it did not harden. We also found a silicone caulking material from a local store. We tried casting a candle template with this material as we did successfully the expensive silicone rubber. However, this material only dried on the surface where it was exposed to air and the inside did not solidify, as seen in Figure 4.18.

Figure 4.16 (left): Star mold (Cane et al.)

Figure 4.17 (middle): Fox mold (Cane et al.)

Figure 4.18 (right): Failure at bottle mold with silicone caulking (Cane et al.)

Instead we dipped a basic cylindrical glass vile in the caulking to layer the material into a thick a mold. The drying process for each layer took a couple hours and at least eight layers created a good mold around a centimeter thick as seen in Figure 4.19. With the cylinder, this process was easily done. We used a more elaborate a metal cup for a second try. Upon removing this candle mold shell, we determined this material got stuck in the ridges of the gems that decorated the edges as seen in Figure 4.20. However, the overall process was still successful. We made four mold attempts with half a kilogram of the material, which cost around 250 Lek (220 USD). When we filled the molds with wax, we had difficulty keeping it from leaking. We used rubber bands at first but we found they caused the mold to collapse and bend as seen in Figure 4.21. We held the mold shut until the candle cooled in about 20 minutes.

Figure 4.19 (left): Layering with caulking (Cane et al.)

Figure 4.20 (middle): Metals and gems (Cane et al.)

Figure 4.21 (right): Rubber bands holding together wax to make candle (Cane et al.)

Paper molds

We tested making inexpensive molds out of paper. We took a piece of notebook paper and folded it together to make a rectangular prism as seen in Figure 4.22. When we tried to tape the edges, the wax seeped out the edges as seen in Figure 4.23. We found when we glued all the edges together, the wax did not leak out of the mold and the basic mold successful made a candle.

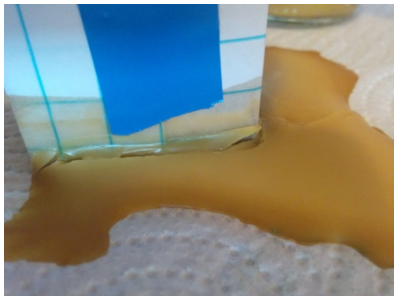


Figure 4.22 (left): Paper mold (Cane et al.)

Figure 4.23 (right): Leaking of paper mold (Cane et al.)

4.3 Cosmetics

4.1.1 Albanian beekeepers' practices regarding cosmetics

Lejla Shehu

From Lejla we learned how substances that bees make play a role in cosmetics. Beeswax and propolis are crucial ingredients in some cosmetic products. Beeswax is to emulsify polar and nonpolar ingredients in creams and lotions. She told us cosmetics can sell for almost triple the price of honey in Albania. Lejla makes cosmetic creams using beeswax as the main ingredient and gives them to her close friends to try. She finds it challenging to sell her creams, as customers buying homemade products want to know the exact ingredients and benefits of the products. This obstacle has discouraged beekeepers from making cosmetics.

Frida

We met with Frida, the executive director of a youth organization called Borderless to discuss the process of making soaps. She is currently working on making

organic soaps from natural herbs and leaves. She said soaps can take at least one month to solidify. Also specific equipment such as lab instruments and a well-ventilated room are needed for the production. Our team determined that soap was not a viable product for us to show beekeepers how to create in our limited time in Albania.

4.1.2 Methods for creating selected cosmetics

Beeswax is used as an ingredient in various cosmetics. We determined what cosmetics to create through further research. There are many recipes online to make wax based cosmetics and most recipes are fairly easy for any level of beekeeper. We kept the recipes as simple and natural as possible. After interviewing Lejla and researching online, we decided to focus on making a lip balm, cold cream, and moisturizing skin lotion.

Production process

Polar and nonpolar ingredients are not easily mixed. Water based ingredients are polar whereas wax and oil based ingredients are nonpolar. The mixing of the two types of compounds are facilitated by heating and cooling. The water based ingredients and oil based ingredients mixed are heated separately using a double boiler set up. Then during the cooling process the two mixtures can be stirred together with a whisk. Essential substances such as vitamins and preservatives can be added for fragrance or extra benefits during the cooling process (Francombe, 2013).

Lip balm

Lip balm is different from creams and lotions. It requires only oil based ingredients that can be melted and mixed in one production step. Almond oil is one crucial ingredient used because of its rich acids that help cross the skin barrier on the lips to stop inflammation (AppalachianBeekeepers, n.d.). Almond oil is easily mixed and heated with beeswax in one step. Vitamin E is added to the mixture as it cools for antioxidant benefits (Krell, 1996). Other oils can be substituted and fragrances can be added to enhance the benefits and scent of the lip balm (Krell, 1996).

Cold cream

A common recipe for a cold cream consists of one part olive oil to three or four parts beeswax and has been used since the second century for its cooling effect on the skin when water is evaporated (Herman, 1998). Olive oil has important components that act as antioxidant, anti-inflammatory and anticoagulant for the skin (Herman, 2011). Beeswax emulsifies the cream and increases the water capacity of the cream (Krell, 1996). Cold cream can have rosewater as an ingredient which acts as a soothing agent for the skin. Rosewater is one ingredient that gives the cream a mixture of vitamins and flavonoids to increase the benefits the cream can have on the skin (Herman, 2011).

Moisturizing lotion

The difference between lotions and creams is that a moisturizing lotion usually has more of a liquid consistency. In most recipes, moisturizing lotion contains high amounts of beeswax to moisturize the skin (Krell, 1996). The oil ingredients can vary depending on the desired medicinal benefits. Almond oil and coconut oil are a common choices because of their healing properties for dry skin and eczema (Krell, 1996).

4.1.3. Feasibility of selected cosmetics

Finding supplies

Although the ingredients for beeswax cosmetics are simple in nature, we had difficulty finding some substances. We searched for borax and lanolin, crucial ingredients for more advanced lotions and creams. When we found those two substances, the pharmacies would not sell them as they used them for medicinal products. Our team decided to focus on making a basic lip balm, cold cream and lotion as ingredients for those recipes were easier to find.

We also could not find some generic supplies such as a 100 mL measuring cup and a thermometer that went over 100°C. Lejla found the measuring cup for us that she had bought from a pharmacy near her home but was unable to locate a thermometer. She said we could find a thermometer at a nearby university lab but because of limited time we decided to make the cosmetics without one.

Our team analyzed the cost to make each cosmetic in Albania based on the recipes in Appendix F. Table 6, 7, and 8 list the ingredients and cost of each ingredient to make the lip balm, cold cream, and moisturizing lotion respectively. We found the main oils, such as coconut and almond oil, to be very expensive for a small amount. We halved the original recipes to compensate for the oils being sold in small quantities. The moisturizing lotion, while more expensive to make, filled three small jars. While the lip balm and cold cream were less expensive to make, less than one jar was produced for each.

Ingredient	Quantity used	Price per container	Cost of quantity used
Almond oil	15 mL	800 Lek	120 Lek
Beeswax	2 tablespoons	_____	_____
Vitamin E	2 capsules	700 Lek	24 Lek
Total			144 Lek

Table 4.6: Cost to create lip balm

Ingredient	Quantity used	Price per container	Cost of quantity used
Beeswax	15 ml	_____	_____
Olive oil	42 ml	525 Lek	40 Lek
Water	15 ml	45 Lek	>1 Lek
Vitamin E	1 capsule	700 Lek	12 Lek
Total			52 Lek

Table 4.7: Cost to create cold cream

Ingredients	Quantity used	Price per container	Cost of quantity used
Coconut Oil	40 ml	1250 Lek	820 Lek
Almond Oil	87 ml	800 Lek	696 Lek
Beeswax	11 ml	_____	_____
Aloe Vera	38 ml		76 Lek
Water	79 ml	1000 Lek	2 Lek
Vitamin E	2 capsules	700 Lek	24 Lek
Total			1618 Lek

Table 4.8: Cost to create moisturizing lotion

Lip balm

Lip balm was the first cosmetic product we made as it was the simplest and had the fewest ingredients. It took about five minutes to melt the almond oil and beeswax, as seen in Figures 4.24 and 4.25. Once a consistent liquid, the mixture was removed and two vitamin E capsules were quickly mixed while cooling. We discovered that the mixture hardens quickly. It took less than a minute for the lip balm to solidify.

Figure 4.24 (left): Melting beeswax and almond oil in a double boiler (Cane et al.)

Figure 4.25 (right): Whisking of ingredients (Cane et al.)

Cold cream

For the cold cream, we found that our scale was not sensitive enough to measure the necessary amount of wax. Instead we used a displacement method shown in Figures 4.26 and 4.27 to measure the wax needed. It took about five minutes for the beeswax to melt before the water could be mixed in. We mixed in the vitamin E capsule as it quickly hardened, similar to what happened with the lip balm.

Figure 4.26 (left): Displacement method before (Cane et al.)

Figure 4.27 (right): Displacement method after (Cane et al.)

Moisturizing Lotion

For the moisturizing lotion we again used the displacement method to measure the wax. Shown in Figure 4.28, the wax and oil ingredients were melted and took ten minutes to harden as seen in Figure 4.29.

Figure 4.28 (left): Coconut oil in beeswax (Cane et al.)

Figure 4.29 (right): Solidification of lotion (Cane et al.)

While solidifying we slowly mixed in the aloe vera and water shown in Figure 4.30. We sufficiently mixed the lotion with a whisk for approximately 20 minutes. The final lotion is shown in Figure 4.31.

Figure 4.30 (left): Mixing after water based ingredients added (Cane et al.)

Figure 4.31 (right): Final lotion product (Cane et al.)

4.4 Pamphlets and Guides

Our team created three instructional pamphlets and three guides with information obtained from completing the propolis lab experiments, crafting candle molds and making candles, and creating three cosmetics: a lip balm, cold cream, and lotion. A formal lab report was also written to compile all of our experiments and scientific research regarding propolis. Each pamphlet condensed useful information for beekeepers to dissolve propolis, make candles, and create cosmetics. The guides focused on presenting useful information accompanied with step by step procedures on successful methods that we recommended.

We created a logical and informative structure for the pamphlets and guides. Professor Petrit and Lejla Shehu, told us to adjust one section of the propolis guide. They told us to add more information about common practices and list before mentioning future scientific possibilities. In addition the pamphlets were translated into Albanian. This translation ensured our information and recommendations were accessible for all Albanian beekeepers. We also received feedback to convert the files from a word document to a publisher file and PDF for ease of uploading online and future distribution purposes.

We found multiple ways to distribute our resources. Physical versions were printed off for RASP and The Albanian Beekeeping Association to have for distribution. Lejla Shehu offered to present our pamphlets and guides at the conference she would be hosting with beekeepers in January 2015. These different means to distribute our pamphlets and guides increases beekeepers' accessibility to our findings and recommendations.

5. Conclusions and Recommendations

In this chapter we discuss the recommendations and conclusions we determined for the three value added products we focused on: propolis extracts, beeswax candles, and cosmetics containing beeswax. These recommendations are based on the results of our interviews, research, and hands-on experimentation. They also include details from our research on harvesting the hive materials and creating the final products. Additionally, we provide recommendations on further expanding our project's work with respect to propolis and wax product processing. Our recommendations can be found in our informational pamphlets and guides that are in Appendices G through L. Lastly, we address recommendations for distributing our resources online and through beekeeping networks in Albania.

5.1 Propolis

The main limitation that beekeepers face in creating propolis tinctures is the extended time it takes to dissolve raw propolis into a solution. Therefore finding an efficient way to dissolve propolis into a solution was the focus of our work with propolis.

5.1.1 Extracting propolis is best done using traps

Our team concluded that some beekeepers use propolis traps while others do not. Our team recommends that beekeepers seeking to collect propolis use traps which allow for easy extraction. These traps are designed with the intention of having honeybees fill them with propolis (Crowder & Harrell, 2012). This method will allow for individuals to collect more propolis that is free of debris. Thus the raw propolis will not have to be cleaned before starting the dissolving process.

5.1.2 Breaking down propolis into a fine powder is important for efficient dissolving

Maximizing the surface area of a substance is a common strategy to increase its dissolving ability. By breaking down raw propolis for the lab experiment, our team concluded turning raw propolis into a powder is ideal for dissolving it more efficiently,

but it takes an extensive amount of time and effort to do so. We found that freezing raw propolis before grating it with a cheese grater was successful, whereas grinding it with a mortar and pestle was not. Our team recommends grating frozen propolis into a fine powder rather than trying to grind it. Beekeepers might use other methods to break up propolis into smaller pieces that requires less time and effort, but these techniques do not create a fine powder. If beekeepers do not want to put in the initial labor to create a fine powder, then the dissolving time will be longer as the surface area of the propolis was not maximized.

5.1.3 A 1:1 mixture of olive oil and ethanol is as efficient as ethanol in dissolving raw propolis and may be used

From the practical lab experiment results, we concluded that using a solution with equal parts ethanol and olive oil is just as efficient as dissolving raw propolis in ethanol. By containing both polar and nonpolar solvents, this mixture might be better used in making cosmetics as some have both polar and nonpolar components. Our team recommends beekeepers try this mixture to minimize the time it takes to dissolve propolis. Olive oil and ethanol are accessible to beekeepers in Albania as ethanol is currently used by beekeepers and olive oil is affordable and located in grocery stores. In addition, since both of these liquids are consumable by humans the resulting propolis solution can be used to create many value added products.

5.1.4 Diethyl ether is very efficient at dissolving raw propolis and should be further researched to determine safe methods for processing and product uses

We also determined from our lab experiment that diethyl ether is a chemical solvent that readily dissolves propolis in a short amount of time. The solvent dissolved a sample of small pieces of raw propolis, not powder, in less than a week. However, diethyl ether is not a practical solution for Albanian beekeepers to use because it poses many safety concerns, as it is volatile, explosive, and flammable. Therefore we do not recommend beekeepers use it in an unmonitored small-scale production process. We recommend that individuals who have access to diethyl ether and know how to handle

it safely further test its ability to dissolve raw propolis. Also, while diethyl ether vapor has been used as an anesthetic in the medical field, further research should be conducted to determine either safe exposure limits or methods of eliminating the hazardous compounds through reactions.

5.1.5 *Frazelinë* is a viable material to filter propolis solutions

In our lab we tried using different materials to filter our solutions. Through these trials we determined that eight layers of chiffon fabric worked well, but not as well as a single layer of *frazelinë*. We also found out from Lejla Shehu that *frazelinë is* a commonly used material for filtering. We recommend beekeepers use a single layer of *frazelinë* as it is was the most affordable and effective material to filter raw propolis from the solutions. This material was found in a local fabric store in Tirana and cost 100 Lek (0.89 USD) for about a square meter of fabric.

5.2 Candles

Often Albanian beekeepers discard beeswax, as they do not take the time or know how to process it into a marketable product. Our project focused on creating valuable wax based products such as candles and cosmetics. We made molds from local materials to ensure Albanian beekeepers could create unique and personal candles.

5.2.1 Cleaning wax is easily done using a gravity settling method

We found that cleaning wax using a settling method and scraping debris from the resulting solidified wax uses minimal supplies. For melting small portions of wax, we recommend that beekeepers use a double boiler set up. The top portion of the double boiler should be a small pot filled with equal amounts of wax and water. The lower portion of the double boiler should be a large pot of boiling water. We recommend that the smaller pot be submerged halfway to quickly melt the wax into a liquid consistency. The melted mixture should be continuously stirred during this process to avoid discoloration until it is poured into a plastic or other flexible container to cool. The wax should be allowed to cool at room temperature to allow all the debris to settle. After two to four hours, the wax can be taken out of the container and the debris can be

removed. At the bottom of the wax block, the dirt and debris can be scraped away with a knife. The water separated below the cooled solid wax can be discarded but should not be poured down a drain. We recommend repeating this process until the desired cleanliness is obtained. This clean wax can be re-melted and used in various methods to make candle and cosmetics.

5.2.2 Natural herbs or crayons can effectively color wax during the melting process

We determined some herbs can add a colored hue to beeswax. We tried placing a tea bag filled with herbs in melted wax. We also simply added herbs to melted wax. The herbs could be removed after settling to the bottom of the wax during the cooling process. We recommend the latter method as it took less time for the color to seep into the wax. More of the spices can be added during this process to create darker hues. We recommend more experimentation be done with various herbs and spices to achieve appealing or desired scents and colors. Crayons are another material used for dying candles. Our research shows that melting crayons into wax can provide more color options. Although this process is not natural, it can make more conventionally appealing candle colors.

5.2.3 Simple candles require few materials to create

Simple candles, such as tapered, rolled, and jar candles can be made with minimal supplies, each of which we recommend to beekeepers who are making candles for the first time. To make a tapered candle, a cotton string wick should be dipped repeatedly into a container of melted wax. We recommend using a container that is as tall as the desired candle height. The cotton string for the wick can be found in hardware stores. We recommend carefully straightening the wick after the first couple dips since the wax will still be pliable rather than using a weight to keep the candle straight. We also recommend dipping in cold water between dipping the candle in wax to cool the wax layers quickly.

Rolled candles can also be made easily. The cotton wick should first be dipped in melted wax as wax covered wicks burn more easily. We recommend cooling wax in a

container to form a thin flat sheet of approximately 2-3 millimeters thick (1/10 of an inch). This can be in the form of a pattered foundation sheet or a smooth sheet. The wick should be placed at the end of the sheet and the wax rolled tightly into a cylindrical shape around the wick.

Jar candles are easy to make but require more expensive materials as beekeepers have to purchase a jar for each candle. As with the rolled candle, we recommend the cotton wick first be dipped in melted wax. The wick should be held straight up in a jar of the desired size so that the melted wax can be poured around the vertical wick. Jars can also be decorated and personalized to increase profit.

Of these options, taper candles and rolled candles require the least amount of materials. Taper candles require a tall pot for holding the melted wax while rolled candles need a flat container to let the wax sheets form in. Jar candles require the purchase of the jars. While the funds for jars might be more than the other options, jar candles have the simplest procedure to create a final candle. Jar candles also have more variability in size as the only restriction is the size of the jar. We recommend each of these candle processes to beginner beekeepers that are looking for an easy way to make candles for the first time.

5.2.4 Elaborate candles can be created using homemade molds

Elaborate and personalized candles can be made using molds. While molds can be bought premade from other countries, homemade molds can be made using local resources. While hard two piece molds made of plaster and ceramic can work in theory, the materials are not readily available in Albania. Rather, we recommend making high quality molds from silicone rubber, an expensive and difficult to find material. This material costs for 8000 Lek (72 USD) per kilogram from select hardware stores in Albania. This silicone rubber material is sold with a smaller container of catalyst. The two parts should be thoroughly mixed together using enough catalyst to cause the silicone rubber to harden. Because of a lack of instructions, this process is largely experimental, however, we recommend using a 5:1 ratio of silicone rubber to catalyst as that proportion proved successful. We recommend casting the mold in a container that

is slightly larger than the desired candle size. We recommend the figurine be placed upside down in the container of silicone rubber so that the top of the figurine does not touch the bottom. After 24 hours, the figurine can be cut out the side and the candle mold can be reused. The mold should stand alone and melted wax can be poured into the hollow cavity left from the figurine.

Silicone rubber is the ideal material for making candle molds, however there are alternatives in Albania that are more available and inexpensive. If this silicone rubber material and catalyst is too expensive, silicone caulking can be used instead. Silicone caulking can cost as much as 16 times less than silicone rubber, being sold at 500 Lek (4.40 USD) per kilogram. We recommend dipping the figurine it in the caulking material approximately eight to ten times with four to six hours between dipping. This will create a mold with a thickness greater than one centimeter. The caulking should cover all parts of the figurine excluding the desired base of the candle. When this is completed, the figurine can be cut out carefully through a slice on the side of the mold. We recommend symmetrical figurines without extremely detailed edges with this material. When filling the mold with wax, we recommend holding the mold closed as it will likely not stand on its own. This makes using silicone caulking molds a slightly more difficult process.

While paper molds are not reusable, they are simplistic and affordable. They can be folded into elaborate geometrical shapes and glued at the seams. A wick is placed in the mold and wax is poured around. When the wax cools, the paper can be peeled off. We recommend allowing the candle to cool in the refrigerator to help remove the paper from the candle.

Another type of mold that we recommend investigating is 3D printed molds. Our research indicates that 3D molds are inexpensive to produce. 3D printer equipment can be found in local workshops in Tirana. Designs can be found online in blueprint libraries and the molds can be anything from one piece cylinders to elaborate two piece molds.

Of these mold materials, the silicone rubber and 3D printed mold material make higher quality molds and can be used to make the most elaborate shapes. Paper molds are the easiest to make but as a result, limit the shape of the candles. Paper and

caulking are the easiest materials to locate in Tirana. These processes should be looked into by anyone interested in increasing the value of their business through advancing their wax related products.

5.3 Cosmetics

Cosmetics take inexpensive components and create a more expensive consumer product. However, many beekeepers are unaware of the processes and the benefits of making cosmetics using beeswax.

5.3.1 Displacement is a reasonable method to weight out small amounts of beeswax

We concluded wax could accurately be measured through a displacement method (White, 1993). As sensitive scales are not always available for beekeepers, we recommend beekeepers use a process of displacement to determine their wax quantities. We recommend this process to beekeepers that deal with small quantities of wax at a time. One liquid ounce of beeswax is one ounce of beeswax by weight. We recommend wax be dropped into a set quantity of water and the displacement in fluid ounces is the weight in ounces of wax. The exact amount of wax desired can be determined in a trial and error method.

5.3.2 Vitamin E should be added during the cooling process

We determined vitamin E capsules are an available source to use in the making of cosmetics. Vitamin E is a helpful ingredient in many cosmetics because of its medicinal benefits. Although vitamin E can be expensive, we recommend beekeepers use it to increase the value of their cosmetics. Vitamin E should be added during the cooling process to maintain its chemical qualities and health benefits.

5.3.3 Lip balm is simple and quick to make but ingredients can be expensive

Our team determined making a basic lip balm is an easy process and the necessary resources are available in Albania. We recommend a lip balm as it can be made quickly and requires only three ingredients. While almond oil can be expensive to buy, not much is required for the recipe. We recommend pouring the melted beeswax

and almond oil into a storage container as soon the vitamin capsule has been mixed in to avoid the lip balm hardening prematurely. The recipe we used can be found in Appendix F.

5.3.4 Cold creams contain simple ingredients that make it economically feasible

We concluded the cold cream recipe used is feasible for Albanian beekeepers because the ingredients were easily obtained. It's cooling and cleansing effects are marketable benefits that make it a valuable addition to a beekeeper's businesses. We highly recommend it, as the required ingredients are affordable. The recipe can be found in Appendix F. The only ingredient for beekeepers to purchase is olive oil, which can be found in grocery stores. For an additional cost, borax can be added to the water components while heating to help emulsify, thicken and preserve the cream.

5.3.5 Lotions require an involved process to make but can be profitable

There are several ways to make a moisturizing lotion. We focused on a recipe that is located in Appendix F. The process of creating a lotion is more complicated than making a lip balm and cold cream as more ingredients are required. We recommend this to beekeepers who have some experience in making cosmetics and have the funds to purchase the materials in advance. Although the recipe calls for a blender, we recommend using a whisk to mix the water and oil components completely. The more advanced moisturizing lotions have a soothing agent called lanolin as the main ingredient, which is sheared sheep's wool. We recommend beekeepers use lanolin in lotion as it can increase its effectiveness. We also recommend using rose water instead of regular bottled water to increase the value of the lotion. While these ingredients are often expensive and hard to find, we recommend if financially possible that beekeepers look for materials like lanolin and rose water at pharmacies or university labs.

5.3.6 Containers for making cosmetics should be used solely for that purpose

By making a basic lip balm, cold cream, and lotion we concluded it is beneficial to have separate containers and instruments for production as wax and other ingredients are not easy to clean. Two small cooking pots are required to boil ingredients and a

larger pot for the bottom part of the double boiler. A stirring whisk is optional but is the most effective way in mixing the two different phases together properly. Small plastic or glass jars should be used as containers to hold the final cosmetic products.

5.4 Distribution

We presented our information and recommendations in three condensed pamphlets and detailed guides that could be distributed to beekeepers in Albania. We recommend these resources be uploaded online to extension services and RASP's website in addition to being printed. This provides access for people of different technological and locational backgrounds. The printed pamphlets should be distributed to different organizations with the help of local contacts to increase the impact. Lejla Shehu has connections in the beekeeping community and is holding a conference at the beginning of 2015. We recommended that she take these pamphlets to the conference and distribute them to interested beekeepers. This gives substance to our recommendations and gives them a better chance of making a difference. We recommend that Lindita Çeçja and her nongovernmental organization, the Association for Gender Integration, take our pamphlets to give to rural community members trying expand their beekeeping efforts. Her organization helps women and children learn how to profit from beekeeping so our pamphlets are directly relevant to their mission. We also created a professional lab report that should be posted on RASP's extension page. This should allow for other scientists interested in the field to have access to our experimental results regarding the dissolving of propolis.

5.5 Future Projects

It is possible that students, organizations, or scientists may want to expand upon our work. There are two major areas in which our project could expand. One aspect is testing methods on a larger scale. Because of constraints on our project such as time and seasonal restrictions, we were unable to thoroughly test all of our questions and hypotheses. Regarding propolis, we recommend extending testing time to determine the duration for completely dissolved propolis. We also recommend that scientists with

experience examine the safety factors of more advanced solvents to create methods that are safe for human consumption. With candles, we recommend finding and testing more accessible materials for candle molds such as 3D printed molds and hard plaster molds. We also recommend testing different herb choices and determining their coloring potential. Regarding cosmetics, we recommend experimenting with more recipes and optional ingredients to test their effect and necessity in the final products. These aspects could be tested to expand upon our recommendations' longevity and reliability.

Gaining a target audience to test our recommendations can also expand upon our project. By working with rural beekeepers, our recommendations can be tested, critiqued, and modified. A strong recommendation we have is to host workshops to teach beekeepers how to advance their practices through the use of our pamphlets and guides.

References

Acetic Acid. (n.d.). from National Center for Biotechnology Information, U.S. National Library of Medicine http://pubchem.ncbi.nlm.nih.gov/compound/176?from=summary - section=Top

Acetone. (n.d.). from National Center for Biotechnology Information, U.S. National Library of Medicine http://pubchem.ncbi.nlm.nih.gov/compound/180?from=summary - section=Top

Aguiar, L. K. (2008). Recent Developments in the Apiculture Sector in Albania: the Insertion of Beekeepers into the EU Honey Supply Chain. *Acta horticulturae*(794), 25-31.

Alxpril. (2013). 3D Printed Candle Mold. Retrieved from http://www.instructables.com/id/3D-Printed-Candle-Mold/

AppalachianBeekeepers (Producer). (n.d.). Beeswax Recipes. Retrieved from http://appalachianbeekeepers.com/uploads/Beeswax_Recipes.pdf

Armorlord. (2013). Make a two part reusable mold using plaster. Retrieved from http://www.instructables.com/id/Make-a-two-part-reusable-mold-using-plaster/?ALLSTEPS

Ballot-Flurin, C. (2012). Patent Application: "Method to Treat Propolis" Under Review. (Journal, Electronic), 5567. http://wpi.summon.serialssolutions.com/2.0.0/link/0/eLvHCXMwY2BQsDRNSTYxTjRONktOM0oySE42SzQ3SgU2lYHVSYop5MwC-A0RSKW5mxADU2qeKIOcm2uIs4curGiMT8nJiQf2DIAdbmD9ZWgoxsCbCFr9nVcC3iWWIsGgYGZgkmZskJJkkQJqEaSlWhqnGqUlWVikWIDOVjE3BgBU6iUL

Bankova, V. (2005). Chemical diversity of propolis and the problem of standardization. *Journal of Ethnopharmacology, 100*, 114-117.

Bee World Projects. (2014). Retrieved October 1, 2012, 2014, from http://www.beeworldproject.org/Projects

BeladAl-ShamApiary. (2010). Trap Propolis. Belad Al-Sham Apiary website.

Bernard, M. A. (2014). Advice to Collect Propolis (pp. 2). http://www.apimab-laboratoires.fr/en,our-partners,beekeepers.html: Apimab Laboratoires.

Berry, J. A., Hood, W. M., Pietravalle, S., & Delaplane, K. S. (2013). Field-level sublethal effects of approved bee hive chemicals on Honey Bees (Apis mellifera L). *PloS one, 8*(10), e76536. doi: 10.1371/journal.pone.0076536

Bogdanov, S. (2004). Beeswax: quality issues today. *Bee World, 85*. http://utahcountybeekeepers.com/Other Files/Information Articles/Beeswax Quality.pdf

Bogdanov, S. (2011). Propolis: Composition, health, medicine: A review. *Bee Product Science,* http://www.bee-hexagon.net*, 4*, 1-40.

Bradbear, N. (2009). *Bees and their role in forest livelihoods: a guide to the services provided by bees and the sustainable harvesting, processing and marketing of their products* (Vol. 19). Rome: Food and Agriculture Organization of the United Nations.

Bradbear, N. (2011). *Beekeeping and Sustainable Livelihoods*. Herndon: Food & Agriculture Organization of the United Nations.

Bradbear, N., Hilmi, M., & Mejia, D. (2004). Albania: Country Pasture/Forage Resource Profiles In A. Shund (Ed.). Rome.

Bregasi, M. (2013). Albania's Rural Sector: Analysis of Institutional Changes, Evolution, Characteristics, and Challenges. *European Scientific Journal, 9*(31), 77-96.

Bröker, U. (2003). ORGANIC APICULTURE - CHANCES AND PERSPECTIVES IN AN EMERGING MARKET. *Apiacta, 4*.

Cane, D., Dawe, M., Ostrowski, J., & Rivard, A. (2014). Value Added Beekeeping Products Experiments. from http://s48.photobucket.com/user/iqpbees14/slideshow/

Cattermole, P. (2013). We use Enviro-dyes in our Colored Beeswax Candles. Retrieved from http://www.purebeeswaxcandles.com/beeswax-blog/we_use_envirodyes_in_our_colored_beeswax_candles

CIA. (2014). The World Fact Book: Albania. 2014, from https://http://www.cia.gov/library/publications/the-world-factbook/geos/al.html

Clarke, M. H. (1999). GENDER AND PARTICIPATION IN NATURAL RESOURCES BASELINE SURVEY.

Cox-Foster, D. L., Geiser, D. M., Martinson, V., vanEngelsdorp, D., Kalkstein, A. L., Drysdale, A., . . . Hornig, M. (2007). A metagenomic survey of microbes in honey bee colony collapse disorder. *Science (New York, N.Y.), 318*(5848), 283-287. doi: 10.1126/science.1146498

Crowder, L., & Harrell, H. (2012). *Top-bar Beekeeping: Organic Practices for Honeybee Health*. White River Junction, Vt: Chelsea Green Publishing.

Cungu, A., & Swinnen, J. F. (1999). Albania's radical agrarian reform. *Economic development and cultural change, 47*(3), 605-619.

De la Rúa, P., Jaffé, R., Dall'Olio, R., Muñoz, I., & Serrano, J. (2009). Biodiversity, conservation and current threats to European honeybees. *Apidologie, 40*(3), 263-284. doi: 10.1051/apido/2009027

De Soto, H. (2002). *Poverty in Albania: a qualitative assessment* (Vol. no. 520). Washington, DC: World Bank.

Dedej, S. (2000). A technical and economic evaluation of beekeeping in Albania. *Bee World, 81*(2), 87-97.

Degraeve, K. (2013). Geometric Candles. Retrieved from http://howdidyoumakethis.com/geometric-candles/

DevonBeekeepers'Association. (2011). Hive products- Propolis. http://www.devonbeekeepers.org.

Dhëmbo, E. (2012). Civil Society in Rural and Remote Areas in Albania (pp. 16-18). Tirana, Albania: Institute for Democracy and Mediation.

Dirina, I., & Bugina, V. (2012). Development Assessment of the Beekeeping Industry in Latvia. *Economic Science for Rural Development*(29), 69-76.

Dobi, P. (2014). First Interview with Sponsor. In D. Cane, M. Dawe, A. Rivard & J. Ostrowski (Eds.).

Dobi, P., & Shehu, L. (2012). Proceeding of the COLOSS Work Shop WG4 "Honey bee vitality and diversity- Behavioral traits: Final results nad paper preparing" *Beekeeping in Albania, current situation and problems*. Ohrid, Macedonia.

Ethanol. (n.d.). from National Center for Biotechnology Information, U.S. National Library of Medicine http://pubchem.ncbi.nlm.nih.gov/compound/702?from=summary - section=Top

Ether. (n.d.). from National Center for Biotechnology Information, U.S. National Library of Medicine http://pubchem.ncbi.nlm.nih.gov/compound/3283?from=summary - section=Top

EuropeanCommission. (2006). Albania Country Report. In V. I. S. Arcotrass Gmbh, EuroCare GmbH and AKI (Ed.).

Fisher, D. (n.d.-a). How to Make Dipped Taper Candles. Retrieved November 16, 2014, from http://candleandsoap.about.com/od/basicinstructions/ss/How-To-Make-Dipped-Taper-Candles.htm

Fisher, D. (n.d.-b). Make a Simple Rolled Beeswax Candle. from http://candleandsoap.about.com/od/projectsforbeginners/ss/ssrolledbw1_5.htm - step-heading

Francombe, G. (2013). Natural Facial Skincare: homestudy course.

Green, T. (2012). Cleaning Beeswax with a Double-Boiler. Retrieved from http://www.lovelygreens.com/2012/08/cleaning-beeswax-with-double-boiler.html

Gross, M. (2011). New fears over bee declines. *Current biology : CB, 21*(4), R137-R139. doi: 10.1016/j.cub.2011.02.001

Hall, D. R. (1996). Albania: Rural development, migration and uncertainty. *Geojournal, 38*(2), 185-189. doi: 10.1007/BF00186668

Hall, D. R. (1998). Rural diversification in Albania. *Geojournal, 46*(3), 283-287. doi: 10.1023/A:1006980805704

Hanley, P. (2014). Case against systemic pesticides deepens. *Star - Phoenix,* p. C.2. Retrieved from http://wpi.summon.serialssolutions.com/2.0.0/link/0/eLvHCXMwY2BQSDFNNEIMNDBJSTYxTjExNktKtDQ1SLVMA1ZNRqkphqkoN0QgleZuQgxMqXmiDHJuriHOHrqwojE-JScn3tgYdFAaMAUZGoox8CaCVn_nlYB3iaVIMCgkgxqKpkALTExTTUwNEhMTLRMtzRKBlZl5clKKWRIAeIMlqg

Herman, S. (1998). Kosmetikos Shake before Using. http://www.stephen-herman.com/002.pdf

Herman, S. (2011). Retro Beauty. http://www.stephen-herman.com/104.pdf

Hoff, F. L., Willett, Lois Schertz. (1994). U.S. beekeeping industry. (Journal, Electronic). http://wpi.summon.serialssolutions.com/2.0.0/link/0/eLvHCXMwY2BQsDRNSTYxTjRONktOM0oySE42SzQ3SgU2lYHVSYop5MwC-A0RSKW5mxADU2qeKlOUm2uIs4dueUFmPHQMIx7Yq7AAHX4lxsCbCFr5nVcC3iGWIsGgYGSYlGhhkpZiaWCcagI6UNzI3NAo1cLExMg8OTHRNBUAsugjvw

Hogendoorn, E. A., Sommeijer, M. J., & Vredenbregt, M. J. (2013). Alternative method for measuring beeswax content in propolis from the Netherlands. *Journal of Apicultural Science, 57*(2), 81-90. doi: 10.2478/jas-2013-0019

Hurley, T. (n.d.). Cleaning Raw Beeswax to Make Candles. Retrieved from http://candles.lovetoknow.com/cleaning-raw-beeswax-make-candles

IFAD. (2010). Rural poverty in Albania. Retrieved September 3, 2014, from http://www.ruralpovertyportal.org/country/home/tags/albania

IMF. (2014). Albania: 2013 IV Consultation and request for extended arrangement. In E. D. International Monetary Fund, Ebrary Academic Complete. (Ed.), *Country Report*. Washington.

IndexMundi. (2014). Albania Imports by Product. from http://www.indexmundi.com/trade/imports/?chapter=04&country=al

Kodderitzsch, S. (1999). Reforms in Albanian Agriculture: World Bank.

Koprencka, L., & Muharremi, O. (2010). Land market in Albania: Unresolved property ownership rights. *Perspectives of Innovations, Economics and Business, 6*(3), 41-44.

Krell, R. (1996). *Value-added products from beekeeping* Retrieved from http://www.fao.org/docrep/w0076e/w0076e00.htm

Lietaer, C. (2009). *Impact of beekeeping on forest conservation, preservation of forest ecosystems and poverty reduction.* Paper presented at the XIII World Forestry Congress. Buenos Aires, Argentina.

McCarthy, M. (2011). Decline of honey bees now a global phenomenon, says United Nations. *The Independent*.

McNeil, M. E. A., & Frazier, M. (2014). BEESWAX THE FIX IT'S IN, AND A WAY TO FIX IT, PART 2 (Vol. 142, pp. 48). Medina: A.I. Root Company.

Mercier, N. (2014). Interview with Worcester Beekeeping Association President. In D. Cane, M. Dawe, J. Ostrowski & A. Rivard (Eds.).

Misha, A. (2014). Albania. Retrieved September 3, 2014, from http://www.fao.org/countryprofiles/index/en/?iso3=ALB

Mullin, C. A., Frazier, M., Frazier, J. L., Ashcraft, S., Simonds, R., Vanengelsdorp, D., & Pettis, J. S. (2010). High levels of miticides and agrochemicals in North American apiaries: implications for honey bee health. *PloS one, 5*(3), e9754. doi: 10.1371/journal.pone.0009754

Naik, D. G., Vaidya, H. S., & Behera, B. C. (2009). Antioxidant properties of Indian propolis. *Journal of ApiProduct and ApiMedical Science, 1*(4), 110-120. doi: DOI 10.3896/IBRA.4.01.4.03

Nel, E., Illgner, P. M., Wilkins, K., & Robertson, M. P. (2000). Rural Self-Reliance in Bondolfi, Zimbabwe: the role of beekeeping. *The Geographical Journal, 166*(1), 26-34.

Partial Collapse. (2013). Retrieved from http://news.softpedia.com/news/Europe-Losing-Up-to-33-Percent-of-Its-Bee-Colonies-Every-Year-436883.shtml - sgal_0

Pence, E. (2010). Natural Candles - Coloring your Candles with Herbs and Spices. Retrieved from http://www.soap-blog.com/2010/05/natural-candles-coloring-your-candles.html

Pettis, J. S., & Delaplane, K. S. (2010). Coordinated responses to honey bee decline in the USA. *Apidologie, 41*(3), 256-263. doi: 10.1051/apido/2010013

Pieroni, A., Nedelcheva, A., Hajdari, A., Mustafa, B., Scaltriti, B., Cianfaglione, K., & Quave, C. L. (2014). Local knowledge on plants and domestic remedies in the mountain villages of Peshkopia (Eastern Albania). *Journal of Mountain Science, 11*(1), 180-193. doi: 10.1007/s11629-013-2651-3

Popa, A. A., Mărghitaş, L. A., Arion, F. H., & Pocol, C. B. (2012). Entrepreneurial behavior in the beekeeping sector as determinant of sustainable development. *Analele Universităţii din Oradea, Fascicula Ecotoxicologie, Zootehnie şi Tehnologii de Industrie Alimntară. XI (A)*, 131-140.

Popova, M., Trusheva, B., Antonova, D., Simone, C., Mifsud, D., Farrugia, C., . . . Bankova, V. (2011). The specific chemical profile of Mediterranean propolis from Malta. *Food Chemistry, 126*(3), 1431-1435.

Pujirahayu, N., Ritonga, H., & Uslinawaty, Z. (2014). Properties and Flavonoids Content in Propolis of Some Extraction Method of Raw Propolis *International Journal of Pharmacy & Pharmaceutical Sciences, 6*(6).

RASP. (2013). Rural Association Support Programme Home Page. Retrieved September 1, 2014, from http://www.rasp.org.al/index.html

Return2Health. (n.d.). Manuka Health Propolis Tincture 25 mls. return2health.net.

Roman, A., Popiela-Pleban, E., Kozak, M., & Roman, K. (2013). Factors influencing consumer behavior relating to the purchase of honey part 2. Product quality and packaging. *Journal of Apicultural Science, 57*(2), 175-185.

Shaw, M. L. (2013). Making Beeswax Candles with Molds. Retrieved from http://www.motherearthnews.com/homesteading-and-livestock/making-beeswax-candles-zbcz1312.aspx - axzz3LQ8wonqw

Sikor, T., Muller, D., & Stahl, J. (2009). Land Fragmentation and Cropland Abandonment in Albania: Implications for the Roles of State and Community in Post-Socialist Land Consolidation. *World development, 37*(8), 1411-1423. doi: 10.1016/j.worlddev.2008.08.0113

Smith, K. M., Loh, E. H., Rostal, M. K., Zambrana-Torrelio, C. M., Mendiola, L., & Daszak, P. (2013). Pathogens, Pests, and Economics: Drivers of Honey Bee Colony Declines and Losses. *EcoHealth, 10*(4), 434-445.

Smooth-On. (2011). Step-By-Step Beginner's Guide to making Candles Molds. Retrieved November 15, 2014, from http://www.smooth-on.com/gallery.php?galleryid=198

Stecklov, G., Carletto, C., Azzarri, C., & Davis, B. (2010). Gender and Migration from Albania. *Demography, 47*(4), 935-957.

Stoakley, M. (2014). Beeswax Candles for Show. Retrieved November 18, 2014, from http://www.honeyshow.co.uk/beeswax_candles_for_show.shtml

Tabllo, D. K., & Orgocka, S. (1986). Kusht teknik propolisi i bleteve Instituti I kerkimeve blektorale dhe I.M.T: Minatuar nga Ministria e ministria e shendeteise and ministria e bujqesise

Thorne. (2014). Plain Shapes Candle Moulds. from http://www.thorne.co.uk/candlemaking/candle-moulds/ts-moulds/plain-shapes

UN-DESA, & OECD. (2013). World Migration Figures: United Nations Department of Economic and Social Affairs.

Warchol, K. (2014). Interview with Massachusetts State Bee Inspector. In D. Cane, M. Dawe, J. Ostrowski & A. Rivard (Eds.).

Wheeler, T. (2012). Solar Wax Melter. Retrieved from http://wheelerwoodworking.blogspot.com/2012/05/solar-wax-melter.html

White, E. (1993). *Super Formulas Arts & Crafts: How to make more than 360 useful products that contain honey and beeswax*: Valley Hills Pr.

WikiHow. (n.d.). How to Add Color to Beeswax. Retrieved November 11, 2014, from http://www.wikihow.com/Add-Color-to-Beeswax

Zall Bastar, K. (2014). Association for Gender Integration. 2014, from http://www.thealbaniancrowd.org/en/item/shoqata-per-integrim-gjinor/

Zimmerman, B. (2011). Drawing comb. Retrieved from http://zeebeeman.com/2011/07/04/drawing-comb/

Appendix A: Interview with Kujtim, a beekeeper who owns a cafe near the Agricultural University of Tirana

This interview was conducted on Thursday November 6th, 2014. The interview was recorded and notes were taken to create this summary. Daniel Cane, Meghan Dawe, Joseph Ostrowski, and Allison Rivard interviewed Kujlim. Professor Petrit Dobi was present and aided in translating during the interview.

Speaking:

Group Interviewers

Kujtim

1. *How long have you been beekeeping?*

   I have been beekeeping for more than ten years.

2. *How big is your apiary?*

   I have 20 hives in total.

3. *Are they all in one location?*

   Yes, all 20 of my hives are in one apiary.

4. *What products do you make?*

   From my hives I collect honey, wax, royal jelly, and propolis.

5. *What value added products do you create?*

   I make propolis tinctures. I use wax to make hive the wax foundations of the frames.

6. *How do you collect and process your propolis?*

   I use a mesh propolis trap to collect it because I consider that to be pure propolis. After freezing it I can ground it into a powder to dissolve. I use one liter of 96% ethanol for approximately 400 grams of propolis. I let that sit for a month for it to dissolve and then I filter it through a mesh. It is easier to dissolve it as a powder.

7. *How do you collect and process your wax?*

   I remove the honey from the wax. I then use a pressure cooker to melt the wax once and filter it through a mesh. I then melt it again with some water and

create a block of wax. Some beekeepers soak wax in water to remove debris from the wax

8. *What obstacles have you encountered in making propolis?*

   It takes a lot of time to dissolve in the alcohol.

9. *Where do you sell your products?*

   I only sell my product at local beekeeper markets.

Appendix B: Interview with Lindita Çeçja, executive director of the Association for Gender Integration

This interview was conducted on Thursday November 2nd 2014. Notes were taken during this interview to create this summary. Daniel Cane, Meghan Dawe, Joseph Ostrowski, and Allison Rivard interviewed Lindita. Her daughters were present and translated parts of the interview.

Speaking:

Group Interviewers

Lindita

1. *Can you tell us more about what the Association for Gender Integration does?*

   It was originally founded in 1999 but officially started doing projects in 2003. It specializes in areas of the Albanian agriculture sector. Located about 22 kilometers outside of Tirana we aim to address very poor rural areas.

2. *What is your involvement and role within this organization?*

   I am the executive director of the association.

3. *Have you done any projects relating to beekeeping recently? Who did it address? Women? Children? Constraints? Was it successful?*

   We focus on educating women. We have had two projects in the Pukë district of Albania involving bees and beekeeping. They were for farmers who were trying to better their livelihoods. We were working with Heifer International and Rotary Club to set up a program to give women a colony to upkeep. The hives were only given to women. We were trying to better the economic situation of farmers there.

4. *Do you know if they are still continuing what the programs started?*

   Yes, they have been successful.

5. *Can you tell us a little more about strategies that you use to educate beekeepers? Pamphlets? Demonstrations?*

   [Had pamphlet in Albanian] **We did trainings, both in the classroom and field training with the women to educate and show them how to take care of a honeybee hive.**

6. *Have you dealt with any projects dealing with improving marketing or production of beekeeping products? What kind of products have you worked with?*

   We focused on helping them set up hives and learn how to take care of them.

Appendix C: Interview with Lejla Shehu, a beekeeper who is also the head of the Albanian Beekeeping Association

This interview was conducted on Tuesday November 18th 2014. The interview was recorded and notes were taken to create this summary. Daniel Cane, Meghan Dawe, Joseph Ostrowski, and Allison Rivard interviewed Lejla. Daniel acted as an interpreter for this interview.

Speaking:

Group Interviewers

Lejla

1. *How did you start beekeeping?*

   I was involved in silkworm research and agricultural development and that was how I became involved with beekeeping. Bees are important for agriculture and so I had completed a lot of research on honeybees and honey production and purification.

2. *How big is your apiary?*

   I have around 65-70 hives right now.

3. *What do you enjoy about beekeeping?*

   I enjoy that it is very complex, as there is much to research and learn about bees. I think that the most beautiful part is the biology of the hive. Their products cannot be replicated by people, we need what only they can make. It is becoming more well known the medicinal purposes of bee products.

4. *How did you get involved with the Albanian Beekeeping Association(ABA)?*

   In 1991 I started acting as the, not president, but head director. My friends that have bees and other beekeepers in Albania come to me with questions and issues that they are having and I try to help them.

5. *What products do you make from your hives (other than honey)?*

   I make propolis tinctures as well as a few kinds of medicinal creams.

6. *What products have you found to be the most popular and profitable?*

   Propolis tinctures. This is a growing area of interest for both beekeepers and customers. The important medicinal purposes are beginning to become more known and so people are more interested in buying propolis.

7. *What are some of the challenges that Albanian beekeepers face?*

   Beekeepers that produce propolis and other products have varying production techniques, which cause customers to be skeptical on what they are buying and sometimes refuse to buy it. Also, a government issued certificate is necessary to export propolis tinctures outside of Albania and to even sell in stores within the country. This certification is difficult to get as it is expensive and so it is more profitable for beekeepers to simply sell on a local scale where they are in direct contact and know with their customers.

8. *How does the ABA help beekeepers sell their products? (Professor Petrit mentioned that there rare organized markets.)*

   We organize fairs around Albania where beekeepers can sell their products. Other than that beekeepers sell to people that they know and that is how they build a customer network to sell their products to. The national organization also provides some basic beekeeping information to beginners on getting started with the trade.

9. *How much does a propolis tincture sell for? How much additional profit can beekeepers gain from selling a propolis tincture?*

   The price of Propolis tinctures can greatly vary, depending on how much people trust the source. If beekeepers produce a good product and customers return to buy more, they can charge more as they are producing good propolis tinctures that people want.

10. *How do you normally sell your products? Is it on a large or local scale?*

    Local scale. I normally sell my creams and propolis to family friends to try. But I have people that trust me and want my propolis tinctures and face creams.

Appendix D: Propolis Lab Report

Testing the Capability of Different Solvents to Dissolve Raw Propolis

Experiment completed at Universiteti Bujqesor I Tiranes,
Tirana, Albania

Sponsored by: Rural Association Support Programme
and Professor Petrit Dobi

Completed as a part of the Interactive Qualifying Project:
Recommendations for Creating Beekeeping Products in Albania

Report and Experiment Completed By:

Daniel Cane
Meghan Dawe
Joseph Ostrowski
Allison Rivard

Table of Contents

Introduction

What is propolis and how is it collected?

Honeybees produce materials which can be used to create valuable products. Propolis is one such substance. It is commonly referred to as “bee glue” and is used to seal parts of the hive. It has many important disinfecting and antibacterial properties which protect the hive from disease and other viruses (Warchol, 2014). It is a complex mixture of polar and nonpolar substances. It is combined with beeswax inside the hive, however, resins and other compounds collected from plants, flowers, and leaf buds give propolis its medicinal benefits (Krell, 1996). Bees collect these ingredients on their body while foraging for pollen and nectar. Thus, every sample of propolis has a unique chemical composition since the variety of available plants differs for every area (Bankova, 2005). This means that the composition of beeswax, resins, and active components that bees collect to create propolis will vary, and greatly depend on hive location.

Beekeepers have developed multiple techniques for collecting propolis for use in medicinal products. The simplest way to collect raw propolis is to scrape it off the surfaces of the hive with a common metal tool, However, propolis collected in that manner typically contains excess wax, dirt, and other undesired residues (Berry, Hood, Pietravalle, & Delaplane, 2013). Beekeepers use propolis traps in the top of the hive that are designed for bees to fill with propolis in order to collect larger amounts of cleaner propolis (Crowder & Harrell, 2012). Once filled with propolis, the beekeeper can remove the trap and the desired raw propolis can be harvested by freezing or melting to remove it from the trap.

How is propolis processed?

An ideal standard process is one that can be recreated and repeated in a timely and efficient manner. There are varying processes to break down propolis; all focus on retaining its antibacterial and anti-inflammatory qualities to produce desired concentrations or forms of propolis for value added products (Krell, 1996). The

determination of propolis extract concentrations can be calculated by specific chemical compositions using advanced techniques or simply by weight of the raw propolis dissolved in solution (Krell, 1996). However, there is no standardized method for processing raw propolis because of two main challenges, propolis composition and solvent choice.

The first challenge being the varying chemical compositions and qualities between propolis samples (Bankova, 2005). Typically high quality raw propolis is composed of 45-55% resins, 25-25% waxes and fatty acids, 10% natural oils, 5% pollen, and 5% other organic minerals (Krell, 1996). Since the quality and composition of each sample varies, it might need to be cleaned and purified to discard any foreign debris such as dead bees, excessive wax and dirt before starting to process it. There are different methods to clean raw propolis once it has been frozen and ground up into smaller pieces or a fine powder. The simplest option is soaking it in water while others require heating too (Bernard, 2014; Hogendoorn, Sommeijer, & Vredenbregt, 2013). Ideally this cleaning step is avoided by collecting high quality raw propolis from regularly cleaned traps as cleaning it can cause important resins to dissolve in the cleaning solution (Bernard, 2014). Some of the important resin compounds, which differ with every propolis sample, are flavonoids, phenolic acids and esters (Krell, 1996).

The second challenge is determining what is the best solvent to use to dissolve the raw propolis. The most common and simplest method involves dissolving raw propolis in a concentrated ethanol solution for an extended period of time, ranging from one to several weeks. Upon completion, the solution is filtered to remove any remaining residues and the solution is diluted or evaporated to the desired concentration or consistency (Krell, 1996). Cloth, mesh or paper filters are used depending on available resources and the volume of the solution that is being filtered. Other procedures exist that involve the same process, just using propylene glycol or olive oil as the dissolving solvent instead (Krell, 1996). In efforts to optimize this process, more organic solvents have been tested including ethyl acetate and benzene (Naik, Vaidya, & Behera, 2009). However, since propolis is used in products that people use on their skin and ingest, the

final presence of solvents in the propolis extracts must be at a safe level for the final uses.

In this lab

While time was not a variable tested in this experiment, the goal would be decreasing the time a beekeepers spends creating extracts by finding a solvent that more readily dissolves raw propolis. The dissolving capabilities of different solvents were tested in this two-part lab experiment. Propolis extracts with concentrations by weight were created using various chemicals and mixed solutions as the dissolving solvent. The amount of raw propolis and volume of the solutions were held at fixed amounts to ensure that an equal ratio of solute to solvent was present in each sample.

In addition to looking at different solvent choices, different methods to break up raw propolis and materials to filter solutions were tested. Maximizing the surface area of raw propolis is important in the dissolving process as it creates more readily available propolis for the solvent to be in contact with and dissolve. Filtering the propolis solution comes after the dissolving step and is important to make a propolis solution that can be later used to make extracts.

Lab Part One: scientific experiment

The solvents that were tested in this first part of the lab experiment were stock solutions of ethanol, acetic acid, diethyl ether, and acetone. These chemicals were used for four main reasons. First, it was crucial to determine important chemical characteristics of a solvent that efficiently dissolves raw propolis. Second, while these chemicals pose safety concerns and are hazardous to humans at varying exposure levels, each are safely used by people in different applications. Third, these chemicals were common and available to test. Lastly, the varying chemical characteristics had the potential to address propolis' nonpolar and polar components.

Ethanol is the standard solvent that is currently used to dissolve propolis and thus acted as the control solution for this experiment. Ethanol is safe for human consumption as it is in alcoholic beverages, but is not ideal for applying to skin as it

causes a stinging discomfort when in contact with a cut or open skin wound ("Ethanol," n.d.). Acetic acid at low concentrations is vinegar and is also safe for consumption ("Acetic Acid," n.d.). Acetone is commonly used as in cleaning products like nail polish remover and can come in contact with skin but can cause dryness ("Acetone," n.d.). However, acetic acid and acetone are similar to ethanol in that they too are not ideal for coming in contact with skin that has an open wound. Lastly, diethyl ether at a certain exposure rate has been used as an anesthetic for humans in the past because it is highly volatile ("Ether," n.d.). All of these chemicals have uses, but can be harmful to people if used in the wrong way or exposed to unspecified amounts. While practical uses of these chemical solvents played a role in selecting what solvents to test, specific safe levels of exposure and consumption for final tinctures were not addressed in this experiment. Only the dissolving process of propolis with these solvents was tested.

These four solvents were mixed with raw propolis pieces and after the course of the week some of the propolis dissolved into solution. The solution with the least remaining undissolved propolis was identified as the best dissolving solvent. The results of this experiment developed the next part of the lab, the practical experiment.

Lab Part Two: practical experiment

The second part of the lab experiment focused on testing everyday solutions that Albanian beekeepers have easy access to use in dissolving raw propolis. The solvents used were ethanol, olive oil, and *raki*. Ethanol was again used as it is the standard solution that beekeepers use to dissolve raw propolis. *Raki, an Albanian alcohol,* was tested, as it can be more available and economic for Albanians to use than ethanol. Olive oil was used as it is readily available and, unlike ethanol and *raki,* has nonpolar characteristics. Control solutions were created of each solvent as well as solutions that mixed olive oil with either ethanol or *raki*. The mixtures allowed testing for two different variables. The first variable was differing concentrations of mixtures and the second was the order of dissolving solution. This part of the experiment allowed for us to create conclusions that are feasible for Albanian beekeepers.

Materials

The following materials and equipment were used in this experiment:

- 250 mL beakers
- 50 mL graduated cylinders
- Acetic acid stock solution
- Acetone stock solution
- Cheese grater
- Chiffon mesh material
- Diethyl ether stock solution
- Elastics
- Electronic mass balance
- Ethanol 96% stock solution
- Extra virgin olive oil
- Freezer
- Gloves
- Goggles
- Mortar and pestle
- *Raki* 40% alcohol by volume
- Raw propolis
- Sealable jars and containers
- *Frazelinë*

Methodology

Lab part one: scientific experiment

The first part of the lab tested the ability of concentrated chemical solvents to dissolve propolis. Because wax is a main component in propolis and conventional solvents do not dissolve wax, dissolving propolis is a time consuming step in the creation of tinctures. Different characteristics of solvents that dissolve propolis efficiently were tested through this lab. Methods of maximizing the surface area and filtering undissolved propolis were also tested.

Preparing the raw propolis

The sample of raw propolis was first frozen completely. Then it was grinded into smaller pieces using a mortar and pestle to create more surface area for better dissolution.

Creating propolis solutions

Stock bottles of acetic acid, 96% ethanol, acetone, and diethyl ether were gathered. Using a 50mL graduated cylinder, 20mL of each solvent were added to separate sealable jars. The jars were labeled on their covers for identification.

Calculations were done to determine a consistent amount of propolis to add to each solution, with the goal of having weight percents between 20-30%. This was determined using each solvent's listed density on the container. With the available raw propolis pieces, four samples of 4.0 grams were measured and added to the 20mL solvents. The solutions were sealed and gently mixed by swirling the jar in a circular motion. Initial observations were recorded.

Dissolving time

The solutions of acetic acid, ethanol, acetone, and diethyl ether were swirled twice a day to facilitate the dissolution. They were stored in a dry, dark place to be monitored and mixed twice a day. Final observations were recorded after a week and filtered.

Filtering the solutions

Each solution was filtered using a chiffon mesh material that was folded into eight layers. The solutions were poured through the chiffon filters into separate jars. The undissolved propolis was collected in the filter. The mesh with the solid leftover propolis was massed on an electric mass balance. Then the solid was cleaned off of the mesh and dried to weigh again. These two measurements were subtracted to find the mass of the solid propolis that did not dissolve into solution for each solvent solution. The final results were recorded.

Lab part two: practical experiment

This part of the lab tested practical solvents to dissolve propolis. Two part mixtures made up of a nonpolar solvent and a polar solvent were tested. Olive oil was used for the nonpolar solvent while ethanol and *raki* were used for the polar solvents. The effect of differing amounts of the solvents was tested, while keeping the total volume constant. Additionally, order of dissolving solvent was tested as a variable by adding the second part of the solution after some of the dissolving time had occurred. Again different methods of maximizing the surface area and filtering undissolved propolis were also tested.

Preparing the raw propolis

A common food grater was used to break down raw frozen propolis into a fine powder. After grating for a short time, the propolis sample would thaw and be placed back into the freezer. This process was repeated until over 40 grams of raw propolis was grated into a powder.

Creating propolis solutions

Extra virgin olive oil and 80 proof (40% ethanol) *raki* were bought from a local store and 96% ethanol was obtained from the lab for this experiment. 50mL sealable jars were bought from a local market. In total, nine solutions were prepared. Three control solutions of 20mL of ethanol, olive oil, and *raki* were prepared. Three different ethanol and olive oil solutions were created; 5mL, 10mL, and 15mL of ethanol were

added to three separate jars. Olive oil was added to the three jars to make the final volume of the mixture 20mL. A solution of 10mL olive oil and 10mL *raki* was created as well. Two more solutions were created, one of only 10mL ethanol, and the other only 10mL of olive oil. These two solutions would have the other part, either ethanol or olive oil, added after a few days' time to test if the order of the dissolving solvent the propolis was in had an effect. After all of these were created, 4.0 grams of propolis were added to each mixture and initial observations were recorded.

Dissolving time

The nine solutions were swirled twice a day to facilitate the dissolution. They were stored in a dry, dark place to be monitored and mixed twice a day. Final observations were recorded after two weeks' time.

Filtering the solutions

The solutions were filtered using a single layer of *frazelinë,* a thin fabric commonly used for filtering, to separate the solid undissolved material from the propolis solution itself. Observations were recorded. The solutions were collected in jars after undissolved propolis was caught in the *frazelinë.* The solid propolis was rinsed with water and dried overnight. The undissolved propolis was massed using an electronic mass balance and values were recorded. This method allowed for the weights to be compared.

Results and Discussion

Lab part one: scientific experiment

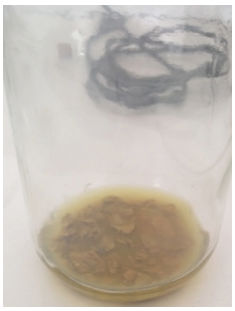
Preparing the raw propolis

Maximizing the surface area of the raw propolis sample was difficult as it thawed quickly when grinding the propolis sample with a mortar and pestle. This technique proved unsuccessful in making the propolis into a powder consistency. Rather, small pieces of propolis were scraped from the mortar and divided the sample up into 4.0 gram samples with similar size propolis pieces to ensure similar amounts of surface area.

Creating propolis solutions

The propolis was placed into the solvents and some observations were immediately visible. The ethanol solution did not show any immediate color change, the diethyl ether solution showed considerable dissolving discoloration, the acetone solution showed slight dissolving discoloration, and the acetic acid solution showed slightly less dissolving discoloration then acetone as seen in Table 1.

Table 1: Solutions immediately after propolis was added

Ethanol	Diethyl ether	Acetone	Acetic Acid
			

Dissolving time

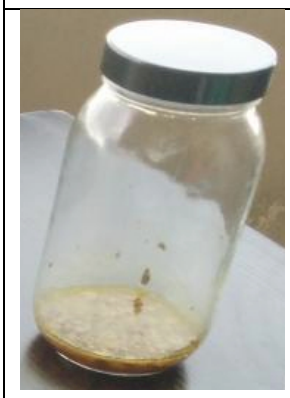
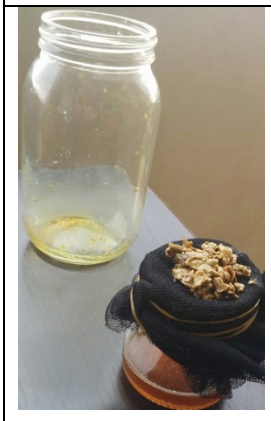
While stirring the solutions twice a day for the following week, observations were recorded of how the solutions were dissolving the propolis. The ethanol solution

was the slowest at dissolving the propolis while the diethyl ether was the fastest and had nearly dissolved all of the propolis by the end of day three. However, because of the high volatility of diethyl ether, by then end of the week the consistency of the solution was more of a paste than liquid. The acetic acid solution appeared to be dissolving it slightly better than the ethanol solution. The acetone solution was dissolving the propolis less quickly than the diethyl ether, but more than the acetic acid and ethanol solutions.

Filtering the solutions

All four solutions at the end of the week before and after filtering are shown in Table 2.

Table 2: Solutions before and after filtering

Solutions at the end of the week			
Ethanol	Diethyl ether	Acetone	Acetic Acid
			
Leftover propolis from each solution that did not dissolve			
Ethanol	Diethyl ether	Acetone	Acetic Acid
			

The weight of the chiffon filters with the propolis that did not dissolve for each sample was weighed, cleaned and weighed again. This should have allowed for the amount of propolis that did not dissolve in each solution to be determined. Listed in Table 3 are the final weights of the original 4.0 grams of propolis that were dissolved in each solution.

Table 3: Masses of leftover propolis from each solution that did not dissolve

Ethanol	Diethyl ether	Acetone	Acetic Acid
6.9 grams	0.9 grams	2.0 grams	5.7 grams

These final masses were inaccurate. Some weights were greater than the initial 4.0 grams because there was not a sufficient amount of time for liquid in the mesh filters to completely dry. This caused liquid to be caught in the mesh filters and the final weight of each propolis sample that did not dissolve to be greater than it actually was. The results of which solution dissolved the most propolis were then determined based on the observations of the remaining propolis as seen in Table 2. Visual observations determined that diethyl ether is most efficient, then acetone, acetic acid and finally ethanol is least efficient in dissolving raw propolis. These results show certain chemical properties are better at dissolving propolis. Diethyl ether is nonpolar solvent and can therefore dissolve wax more easily than ethanol, a polar solvent. However, the resins that make up propolis are polar and are therefore more easily dissolved into ethanol than diethyl ether. Because of the safety concerns regarding the ability to use these chemicals in products that people use on their bodies, ethanol remains the safest solvent to dissolve raw propolis. However, these results show the possibility that a mixture of a nonpolar solvent and a polar solvent might be a more efficient, yet safe way to dissolve raw propolis.

Lab part two: practical experiment

Preparing the raw propolis

To better maximize the surface area of the propolis sample, a kitchen grater was used to shave the raw propolis sample into a powder. The entire propolis sample was frozen to grate easily. This technique proved successful, although it did take significantly more time because of how quickly the propolis thawed while grating. When this happened, the propolis sample had to be refrozen and sometimes the grate had to be cleaned. For this small-scale experiment, this increased time was only inconvenient, however for a larger operation, the time commitment might prove to be unsuitable.

Creating propolis solutions

While the different mixtures of olive oil and ethanol or *raki* were being created, important observations were made before the propolis was added. Each solution, excluding the control solutions, exhibited a two-phase system. The nonpolar oil and the polar alcohols did not mix, as a distinct boundary between the solvents was visible. After the propolis was added to the mixture and settled, it rested in between the oil and alcohol layer.

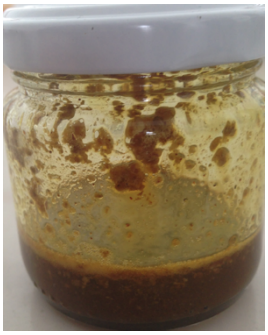
Dissolving Time

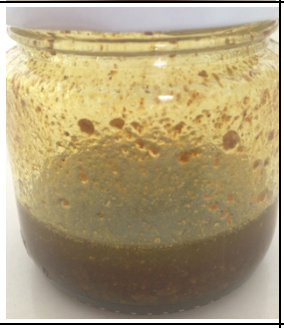
During the two weeks the solutions were dissolving, a few key observations were noted. The most noticeable was the disappearance of the distinct boundary between the polar and nonpolar phases. This could be caused just by the color change while the propolis was dissolving, as the entire solution turned to a dark brown color. However, it is possible the nonpolar solvent and the polar solvent were dissolving their respective parts of the propolis and created a homogeneous mixture. The solution of 10mL of ethanol with the delayed addition of olive oil created a very viscous paste. When the olive oil was added, it just sat on top of the viscous paste layer. On the other hand, the solution that had 10mL of olive oil with the delayed addition of ethanol had the same appearance at the 1:1 ratio mixture of ethanol and olive oil. Unlike the dark brown ethanol and olive oil mixtures, the *raki* mixtures were a lighter brown color.

Filtering the mixtures

At the end of the two weeks, the solutions before and after filtering are shown below in Table 4.

Table 4: Images and observations of solutions at end of dissolving period

Solution	Initial Solution	Final Solution	Observations
Olive Oil (control)			Initial: Propolis sank in solution. Could not see color change as oil has tinted color. Final: Still had significant amount of solid propolis. The color was lighter than ethanol.
Raki (control)			Initial: After some time slight color change occurred after propolis was added. Final: Still had significant amount of solid propolis. The color was significantly lighter than ethanol.
Ethanol (control)			Initial: Compared to *raki* and olive oil solutions, showed the most immediate color change. Took time for propolis to sink into solution. Final: Had the most viscous consistency and darkest color. Significantly less solid propolis than *raki* and olive oil solutions.
Ethanol and Olive Oil (1:1)			Initial: The olive oil was above the ethanol and the propolis was suspended between them. Final: Compared to ethanol control solution: Color appeared as dark, was less viscous and had similar amount of solid propolis compared to ethanol.

Ethanol first, then olive oil (1:1)			Initial: Same as ethanol control solution observations. Midweek: When olive oil was added to ethanol, the propolis appeared to stay in the ethanol with the olive oil resting above. Final: Slightly less dark than Ethanol and Olive Oil (1:1) solution.
Olive Oil first, then ethanol (1:1)			Initial: Same as olive oil control solution observations. Midweek: When ethanol was added to the olive oil, the propolis appeared to lay in-between the two solvents Final: Slightly less dark than Ethanol and Olive Oil (1:1) solution.
Ethanol and Olive oil (3:1)			Initial: The olive oil was above the ethanol and the propolis was suspended between them. Final: Had more solid propolis than Ethanol and Olive Oil (1:1) solution.
Ethanol and Olive Oil (1:3)			Initial: The olive oil was above the ethanol and the propolis was suspended between them. Final: Had more solid propolis that Ethanol and Olive Oil (3:1) solution.
Olive Oil and *Raki* (1:1)			Initial: The olive oil was above the *raki* and the propolis was suspended between them. Final: Propolis seemed to settle in *raki* below olive oil. Was a darker color than *raki* control solution. Had as much solid propolis left as *raki* control solution.

The mixtures were filtered using *frazelinë,* then all rinsed with water to remove any lingering solution and left to dry shown in Figure 1.

Figurer 1: Filter solid propolis from solution using frazelinë

However, again the weighing process proved difficult. Inaccurate weights were obtained primarily because of the insufficient available drying time. This can be due to a few factors. Olive oil does not dry or evaporate easily as it is viscous. Residues can remain even after rinsing with water. However, the rinsing method was repeated for every sample so that the measurements could be compared. Through these measurements seen in Table 5, the 1:1 olive oil with ethanol mixture was just as effective as the ethanol solution, having only 2.4 grams of undissolved material to ethanol's 2.2 grams. Again, there is some error due to incomplete drying. However, the comparable weights for ethanol and olive oil with ethanol solutions were significantly different from those of the other solutions.

Table 5: Weights of undissolved propolis for each solution

Solution (20mL) with 4 grams propolis	Weight of undissolved propolis (grams)
Olive Oil	4.1
Raki 80 Proof	4.1
Ethanol 96%	2.2
Ethanol (10mL) and Olive Oil (10mL)	2.4
Ethanol (10mL) then later Olive Oil (10mL)	3.7
Olive oil (10mL) then later Ethanol (10mL)	3.5
Ethanol (15mL) and Olive Oil (5mL)	3.4
Ethanol (5mL) and Olive Oil (15mL)	4.5
Raki (10mL) and Olive Oil (10mL)	4.5

Conclusions

Lab part one: scientific experiment

Our team concluded that diethyl ether was the best at dissolving raw propolis out of the solvents tested. We concluded from the chemical properties of diethyl ether that its strong nonpolar structure dissolves the wax most effectively. However, diethyl ether has a dipole moment, meaning that it does exhibit some polar qualities as well and therefore readily dissolved the resins. For those reasons, we believe that is why it was the most effective at dissolving the nonpolar wax and the polar resins in propolis.

Although diethyl ether was very effective, there are serious safety and health risks involved in using this solvent. It is volatile at room temperature. The vapors are also flammable. Diethyl ether is a skin and respiratory irritant with a short term exposure limit of around 200 ppm in a 15 minute period. These qualities make diethyl ether not favorable for use in creating propolis products for human use, unless further research and testing is done to ensure removal of the ether. However, the conclusion that nonpolar solvents dissolve wax the best and polar solvents dissolve the resins more effectively assisted us in phase two of our experiment.

Lab part two: practical experiment

The safety concerns from part one of this experiment led our team to design a more practical experiment for part two. As seen in the results, we determined that the 1:1 mixture of olive oil and ethanol dissolved propolis at a comparable rate to only ethanol. This is important because they use materials that any level beekeeper has access to and can use safely. Also, since high quality ethanol can be expensive, the alternative method that we proposed using an olive oil mixture would be cost-effective. This would half the amount of ethanol needed for dissolving the propolis. More importantly, olive oil has no safety concerns associated with it since it is already a component in cosmetics everywhere and also an ingredient in many foods we eat. We conclude that the 1:1 ethanol and olive oil mixture is a viable alternative to dissolve raw propolis.

References

Acetic Acid. (n.d.). from National Center for Biotechnology Information, U.S. National Library of Medicine http://pubchem.ncbi.nlm.nih.gov/compound/176?from=summary - section=Top

Acetone. (n.d.). from National Center for Biotechnology Information, U.S. National Library of Medicine http://pubchem.ncbi.nlm.nih.gov/compound/180?from=summary - section=Top

Bankova, V. (2005). Chemical diversity of propolis and the problem of standardization. *Journal of Ethnopharmacology, 100*, 114-117.

Bernard, M. A. (2014). Advice to Collect Propolis (pp. 2). http://www.apimab-laboratoires.fr/en,our-partners,beekeepers.html: Apimab Laboratoires.

Berry, J. A., Hood, W. M., Pietravalle, S., & Delaplane, K. S. (2013). Field-level sublethal effects of approved bee hive chemicals on Honey Bees (Apis mellifera L). *PloS one, 8*(10), e76536. doi: 10.1371/journal.pone.0076536

Crowder, L., & Harrell, H. (2012). *Top-bar Beekeeping: Organic Practices for Honeybee Health*. White River Junction, Vt: Chelsea Green Publishing.

Ethanol. (n.d.). from National Center for Biotechnology Information, U.S. National Library of Medicine http://pubchem.ncbi.nlm.nih.gov/compound/702?from=summary - section=Top

Ether. (n.d.). from National Center for Biotechnology Information, U.S. National Library of Medicine http://pubchem.ncbi.nlm.nih.gov/compound/3283?from=summary - section=Top

Hogendoorn, E. A., Sommeijer, M. J., & Vredenbregt, M. J. (2013). Alternative method for measuring beeswax content in propolis from the Netherlands. *Journal of Apicultural Science, 57*(2), 81-90. doi: 10.2478/jas-2013-0019

Krell, R. (1996). *Value-added products from beekeeping* Retrieved from http://www.fao.org/docrep/w0076e/w0076e00.htm

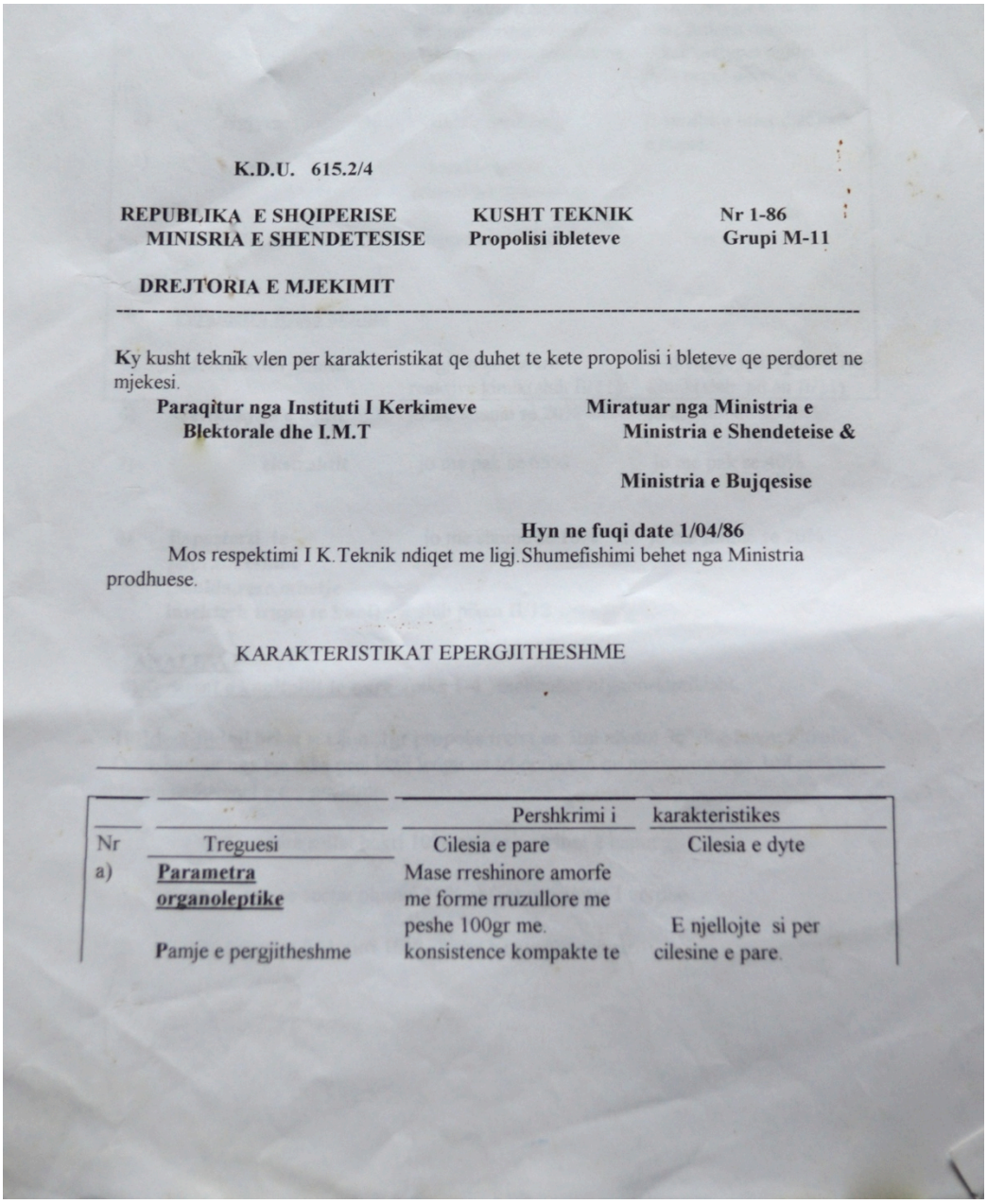
Naik, D. G., Vaidya, H. S., & Behera, B. C. (2009). Antioxidant properties of Indian propolis. *Journal of ApiProduct and ApiMedical Science, 1*(4), 110-120. doi: DOI 10.3896/IBRA.4.01.4.03

Warchol, K. (2014). Interview with Massachusetts State Bee Inspector. In D. Cane, M. Dawe, J. Ostrowski & A. Rivard (Eds.).

Appendix E: Experiment Test Quality of Propolis in Albanian

Lejla Shehu gave this experiment to our group. It is a published experiment that was completed in Albania in 1986 that explains how the quality of raw propolis can be determined through a simple test. Our team did not preform this experiment, as we were not creating propolis extracts only focusing on dissolving propolis more efficiently.

Page 1 of 4



K.D.U. 615.2/4

REPUBLIKA E SHQIPERISE
MINISRIA E SHENDETESISE

KUSHT TEKNIK
Propolisi ibleteve

Nr 1-86
Grupi M-11

DREJTORIA E MJEKIMIT

Ky kusht teknik vlen per karakteristikat qe duhet te kete propolisi i bleteve qe perdoret ne mjekesi.

Paraqitur nga Instituti I Kerkimeve Blektorale dhe I.M.T

Miratuar nga Ministria e Ministria e Shendeteise &

Ministria e Bujqesise

Hyn ne fuqi date 1/04/86

Mos respektimi I K.Teknik ndiqet me ligj.Shumefishimi behet nga Ministria prodhuese.

KARAKTERISTIKAT EPERGJITHESHME

Nr	Treguesi	Pershkrimi i Cilesia e pare	karakteristikes Cilesia e dyte
a)	**Parametra organoleptike**	Mase rreshinore amorfe me forme rruzullore me peshe 100gr me.	E njellojte si per
	Pamje e pergjitheshme	konsistence kompakte te	cilesine e pare.

		bute deri te forte ,me siperfaqe te lemuar dhe me siperfaqe te prerjes te shkelqyer. -E njetrajteshme si nga ngjyra dhe paraqitja -kompakte e forte por qe merr formen me dore. -kur pertypet kthehet ne mase plastike.	-jo dhe aq e njetrajteshme nga ngjyra dhe paraqitja -kompakte e bute qe merr formen me dore. -kur pertypet ngjitet si dylli neper dhembe.
2)	**Ngjyra**	-Kafe e murrme	E verdhe e erret deri kafe e hapet.
3)	**Era;**	-karakteristike aromatike(balsamike)	
4)	**Shija;**	djegese ne te hidhur.	
b)	**Parametra fiziko kimike**		
5)	**Identifikimi kimik**	Ngjyrosje me tre reaktive kimik(shih II/11)	Ngjyrosje me tre reaktive kimik(shih piken II/11)
6)	**Permbajtja e dyllit**	jo me shume se 20%	jo me shume se 40%
7)	**Mbetje te ekstraktit**	jo me pak se 65%	jo me pak se 40%
8)	**Papasterti te papranueshme (ashkla,rere,mbetje insektesh trupa te huaj)**	jo me shume se 10% shih piken II/12	jo me shume se 20%

ANALIZAT

9)**Kerkesat e kapitullit te pare** ;(pika 1-4)analizohet organo-leptikisht.

10)Identifikimi behet si vijon ;1gr propolis tretet ne 5ml alkool 96° dhe lengu filtrohet. Duke hedhur nga nje pike prej ketij lengu ne tri epruveta qe permbajne nga 1ml reaktiv, shfaqen reaksionet e me poshtme;

- me tre tesire sulfat bakri 10%,ngjyre e gjelber e hapur
- me tretesire acetat plumbi 10% shfqet precipitat I verdhe.
- me tretesire 3 kloruri 10% ngjyre e murrme e zeze.

11) Percaktimi i dyllit i fraksionit te treteshem ne alkool 96°dhe i papastertive mekanike;

-5gr propolis (I grimcuar sa me imet zihet per nje ore me 50 ml alkool 96° ne banjo mari, ne nje ballon qelqi te paisur me refrigjerant vertikal.Ekstrakti filtrohet menjehere i ngrohte ,nepre leter filtri te rralle (peshuar paraprakisht)te ngrohur me pare se bashku me hinken ne temperaturen 80°C. Ky proces perseritet 3 here ne alkool tjeter kurse, filtrimi behet po aty ku eshte bere radhen e pare. Mbetja ne filter megjithe filter peshohet (pas tharjes deri ne peshe konstante)dhe prej peshes se filtruar zbritet ajo e letres se filtrimit;-kjo vlere e shprehur ne % perfaqson fraksionin e papastertive mekanike dhe llogaritet si vijon .

% papastertive mekanike =20 x (b-a) ku;

a = pesha e letres se filtrit
b = pesha e letres se filtrit me gjithe mbetjen.

-Filtrati i ftohur ne 18°C, filtrohet permes leter filtrit ;mbetja ne filter ,e shprehur ne % perfaqson **fraksionin e dyllit** i cili llogaritet si vijon ;

% e dyllit = 20 x (b-a) ku;
a dhe b jane perkatesisht peshat e filtrit bosh dhe e filtrit me dyll.

- Filtrati alkoolik qe fitohet pas vecimit te dyllit, avullohet deri ne peshe konstante;kjo peshe e shprehur ne perqindje perfaqson **fraksionin e treteshem ne alkool** dhe llogaritet si vijon;

% e fraksionit te treteshem ne alkool 96°C = 20 x (b-a) ku;

a dhe b jane perkatesisht peshat e enes (ose e pezafiltrit) bosh dhe ne mbetjen e pare.

III. AMBALAZHIMI DHE MARKETIMI;

13. Ambalazhimi; Masat rruzullore te propolisit ambalazhohen ne qeska te dyfishta plasmasi, ne sasi sipas kerkesave te bleresve ,qeskat prej plasmasi futen ne arka ose thase jute (kanavase).

14.**Etiketimi;** Cdo ambalazh duhet te shoqerohet me etikete ku shenohet emri i entes grumbulluese, pesha bruto dhe neto e pakos numeri i kushtit teknik, kategoria e propolisit, emri i kontrolluesit .

IV.DEPOZITIMI DHE TRANSPORTIMI

15.**Ruajtja e mallit** behet ne vende te mbuluara te thata, te pastra te erreta e te ajrosura

16.**Transportimi** ;Behet me mjete transporti te mbuluara per t'u mbrojtur nga lageshtia dhe cdo gje tjeter qe shkakton demtimin e mallit.

V RREGULLAT E MARRJES NE DOREZIM DHE VERIFIKIMI I KERKESAVE TEKNIKE

16. Bleresi e merr mallin ne dorezim ne entin grubullues te shoqeruar me flete analizen perkatese. Ne rast dyshimi bleresi ka te drejte te marre kampion mesatar ne 10% te kontigjentit (malli qe eshte per dorezim te menjehereshem)por jo me pak se ne 5 pako. Mostra mesatare me peshe rreth 100gr,ndahet ne dy pjese te barabarta nga te cilat njera merret per te verifikuar kerkesat e ketij kushti,ndersa tjera ruhet ne nje vend te miratuar nga te dy palet.,per perseritje analize.,ne rast se nje gje e tille kerkohet. Kur nga kontrolli rezulton se malli nuk ploteson kerkesat teknike,analiza perseritet duke marre dyfishin e sasise.Ne rast se edhe ne proven e dyte kontigjnti nuk i pergjigjet kerkesave te kushtit teknik, atehere ai konsiderohet jashte standartit dhe bleresi ka te drejte t'ja ktheje mallin shitesit.

Qellimi ; Propolisi i bleteve hyn si lende e pare ne perberjen e pomades,ekstraktit dhe te tinktures se propolisit te cilet kane veti antimikrobike,analgjezike dhe rigjeneruese per indet e demtuara dhe ndihmon epitelin e plageve.

MIRATOHET

ZV.Ministri I Shendetesise
Dr Katerina Tabllo

Zv Ministri I Bujqesise
Stavri Orgocka

(shih origjinalin e firmosur dhe te vulosur)

Appendix F: Cosmetics Recipes

These are the materials, ingredients, and procedures we followed to create a simple lip balm, cold cream, and moisturizing lotion.

Materials needed for production

- Stirring Whisk
- Blender (if possible)
- Measuring Cup
- 2 small cooking pots or sauce pans
- 1 big pot (to hold water for double boiler)
- A digital scale (displacement method can be used if scale not found)
- Small containers for storage

Lip Balm

Ingredients

- 4 Tablespoons Almond oil
- 2 Tablespoons Beeswax
- 2 Vitamin E capsules

Procedure to make

1. Place the beeswax in the small pot and let it sit there until melted
2. Once melted add the almond oil into the pot and then stir until mixing
3. After 3-5 minutes, take the pot out of the double boiler to cool
4. Quickly add the vitamin E capsule as the beeswax will harden very fast
5. Mix the ingredients together and then pour into a container

Cold Cream

Ingredients

- ½ ounce beeswax
- 42 mL Olive oil

- 15 mL water
- 1 Vitamin E capsule

Procedure to make

1. Add the beeswax and olive oil into the small double boiler pot
2. Place the water on a stove top to warm make sure it does not boil
3. After about 5 minutes take the small pot out of the double boiler and gradually add the warm water into it
4. Begin mixing the ingredients
5. While mixing add the vitamin E capsule
6. Add the cold cream into a container as it will harden in about 2 minutes

Moisturizing Lotion

Ingredients

- 40 mL coconut oil
- 87 mL almond oil
- 3/8 ounce beeswax
- 38 mL aloe vera
- 79 mL water
- 2 vitamin E capsules

Procedure to make

1. Add beeswax and coconut oil to top of double boiler and mix until melted.
2. After melting, add almond oil and mix the ingredient together with a whisk
3. Take the small pot out of the double boiler and pour into another pot to cool and let it solidify
4. Measure aloe vera and water (water based ingredients) with measuring cup.
5. Slowly add the water based ingredients into the solidified oil based ingredients and mix
6. Mix the ingredients together for 5 minutes or until consistent mixture
7. Place finished lotion into jar or container

Appendix G: Propolis Pamphlet

English Version

Side 1

What is Propolis?

- Complex substance of resins, wax, and other compounds
- Collected from plants, flowers and leaf buds
- Every sample's composition differs greatly depending on hive location
- Collected on honeybees' hind legs

Why is it Important?

- Bees use propolis for sealing cracks, disinfecting different hive areas, and as a barrier from pests
- Propolis tinctures are used to treat allergies, skin irritations, weakened immune systems, burns, and acne
- Propolis has anti-inflammatory, antioxidant, antiviral, antifungal, antibacterial, and antitumor qualities

RASP

Contact
"Dritan Hoxha" Street,
TeknoProjekt building 2, ap.28
PO.Box 2415/1 , 1001
Tirana, Albania

office@rasp.org.al

All information was extracted from the report "Value Added Products for Beekeepers in Albania" on the WPI Project Database. For sources and references please refer to full report.

This guide was compiled by WPI students Daniel Cane, Meghan Dawe, Joseph Ostrowski, and Allison Rivard.

For more information please refer to the propolis guide.

WPI

Information for beekeepers for

Processing Propolis

This pamphlet discusses extraction and processing techniques to break down raw propolis into a solution that can be used to create value added products.

December 2014
Tirana, Albania

Side 2

Extraction

- Use propolis traps to collect larger amounts of pure propolis
- Honeybees fill the gaps of these mesh, metal or plastic lattices that go in the top of langstroth hives


- Freeze propolis traps to remove propolis more easily
- Empty traps regularly to collect cleanest and purest propolis samples

- Propolis can also be scraped off hive surfaces

- Heating or rinsing might be needed to clean propolis of impurities but is not recommended

Dissolution

Important Factors:

Preparation of raw propolis

- Clean and free of debris
- Maximum surface area, break down into the smallest pieces possible
- Grating frozen propolis is most efficient

Dissolving solvent

- Capable of breaking down all components of propolis
- Safe for humans to ingest and apply on skin
- Popular choices are ethanol and propylene glycol

Dissolving time

- One of the main challenges
- Currently takes 3 weeks to a month to fully dissolve in ethanol
- Wax component often takes longer to dissolve

Alternative Methods Tested

Mixture of Ethanol and Olive Oil

- A mixture of equal amounts, a 1:1 ratio, of olive oil and ethanol
- Similar rates for dissolving compared to a standard 96% ethanol solution
- Final solution will be part olive oil and part ethanol which can be beneficial for products with water and oil components

Filtration

- Solutions must be filtered to remove any impurities after dissolving
- Pour the propolis solution onto the filter material as seen below
- Material X is advised


Dilution

- Determine the initial propolis concentration
- Allow some of the ethanol to evaporate
- If you add the same amount of water as the ethanol lost to evaporation, the propolis concentration will remain the same
- Varying amounts of alcohol evaporation and water dilution can vary the composition of the solution depending on the final product use

Albanian Version

Side 1

Cfarë është Propolis?

- Substancë komplekse rrëshire, dyll dhe përbërës të tjerë
- Mbledhur nga pemët, lulet dhe gjethet e burbuqeve
- Cdo mostër ndryshon në varësi të vendodhjes së koshërës
- Mbledhur në këmbët e mbrapme të mjaltit

Pse është i rëndësishëm?

- Bletët përdorin propolis të ngjitur carjet, disinfektim zonat e ndryshme të kosherës dhe si një barrier ndaj insekteve
- Tretësiart e propolis përdoren për të trajtuar alergjitë, irritimet e lëkurës immunitet të dobët, djegjet dhe aknet
- Propolis ka antibakteriale, antifungale, antivirusal, anti irritues, anti oksidant dhe cilësi antitumoriale

RASP

Kontact
Rruga "Dritan Hoxha"
TeknoProjekt Building 2, ap28
PO Box 2415/1, 1001
Tirane, Albania

I gjithë informacioni është njerrë nga raporti "Value Added Products for Beekeepers in Albania" në të dhënat e projektit WPI. Për burime dhe referenca ju lutemi referohuni raportit plotë.

Ky udhëzues është përpiluar nga studentët e WPI, Daniel Cane, Meghan Dawe, Joseph Ostrowski, dhe Allison Rivard.

Për informacioni të mëtejshme ju lutemi referohuni udhëzuesi propolisit.

WPI

Informacion për Bletarët për të bërë

Procesi i propolisit

Kjo broshurë do të diskutojë ekstraktin dhe teknikat e procesit për ta kthyer propolisin në një solucion që mund të përdoret për vlera të shtuar produkteve.

Dhjetor 2014
Tiranë, Shqipëri

Ekstrakti

- Përdor kurthe propolisi për të mbledhur shuma të propolisit të pastër
- Bletët mbushin boshllëqet e këtyre metaleve rrjete e cila shkon në majë të kosherës


- E ngrin kurthet e propolisit për ta hequr me lehtë atë
- I boshatis kurthet për të mbledhur mostra propolisi të pasta

- Gjithashtu propolis mund të kruhet nga sipërfaqa e kosherës
- Nxehja ose shplarja mund të jetë e nbevojshme për të pastruar propolis nga papastëritë por nuk rekomandohet

Shpërbërja

Faktorë të rëndësishëm

Përgatitja e Propolisi

- Të pastër dhe të lirë të mbeturinave
- Zona maksimale sipërfaqe, prishen në copa më të vogla të mundshme
- Propolisi i bezdisshëm i ngrirë është më efikas

Shpërndarja tretës

- Të aftë për të thyer të gjitha komponentët e Propolisi
- Të sigurt për njerëzit që të ha dhe të aplikoni në lëkurën
- Zgjedhje të re janë të etanolit dhe propylene glycol

Shpërndarja kohë

- Një nga sfidat kryesore
- Aktualisht merr 3 javë për një muaj për të shpërndarë plotësisht në etanol
- Komponent qiri shpesh merr më të shpërndajë

Metoda alternative të testuara

Përzierje metanoli dhe vaj ulliri

- Përzierje e shumës së barabartë 1:1 etanolit dhe vaj ulliri
- Norma të ngjashme për shpërbërje krahasuar me standartin 96% të solucionit etanol

Filtrimi

- Solucioni duhet të filtrohet për të hequr papastërtitë pas shpërbërjes
- Hidh e propolisi mbi materialin filtër siç shihet më poshtë
- Këshillohet frazeline


Hollimi

- Përcakto koncentratën fillestrae të propolis
- Lërë etanolin të avullojë
- Nëse i shton ujë kur etanoli humbet avullimin koncentrat e propolis do mbetet e njëjtë
- Shuma e alkolit të avulluar dhe hollimi ujit mund të ndryshojnë përbërjen e solucionit në varësi të produkti final të përdorur

Appendix H: Candles Pamphlet

English Version

Side 1

Why is candle making important?

- Wax has been used for many purposes dating as far back as the ancient Egyptians
- Wax can be sold for three times as much as honey
- 20% of traded wax is used for creating candles
- Beeswax candles stand straighter and drip less than paraffin candles
- Simple steps such as adding color of choosing more elaborate shapes can add market value to candles

RASP

Contact
"Dritan Hoxha" Street,
TeknoProjekt building 2, ap.28
PO.Box 2415/1 , 1001
Tirana, Albania

office@rasp.org.al

All information was extracted from the report "Value Added Products for Beekeepers in Albania" on the WPI Project Database. For sources and references please refer to full report.

This guide was compiled by WPI students Daniel Cane, Meghan Dawe, Joseph Ostrowski, and Allison Rivard.

For more information please refer to the candles guide.

WPI

Information for beekeepers for

Making Candles

This pamphlet discusses candle making from start to finish including cleaning and coloring wax, creating simple candles, and creating candle molds.

December 2014
Tirana, Albania

Cleaning

- Use a double boiler, a smaller pot over larger pot of boiling water, to clean wax
- Place equal wax and water in the smaller pot

- Pour melted wax into a flexible container
- Let cool at room temperature
- Remove block of wax and scrape off debris from bottom
- Repeat until desired cleanliness

Coloring

Natural

- Choose herbs with desired color and scent
- Heat and stir wax and herbs for 30 minutes
- Pour melted wax into a flexible container
- Scrape off remaining solid spices from bottom

Crayons

- Mix crayon pieces in with melted wax to add color

Candle Making

Taper

- Take cotton twine and coat it in melted wax to make wick
- Dip in wax and let cool
- Repeat until thickness desired
- Optional
  - Use weight at bottom
  - Dip in water to cool faster

Rolled

- Form thin sheets of wax, such as foundation sheets
- Roll around a wick

Jar

- Pour melted wax into glass jars with wick already dipped in wax
- Keep wick straight

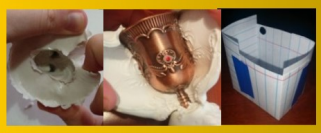
Molded

- Make a mold (instructions on next page)
- Pour melted wax into mold around wick and let cool

Mold Making

Silicone Rubber

- Buy silicone rubber and catalyst material that are sold together
- Found in select hardware store
- Pour silicone rubber into a container and mix in catalyst
- Place figurine upside down in the container
- Let harden and cut out the figurine



Silicone Caulking

- Buy liquid caulking material
- Take figurine and dip into that caulking
- Create 8-10 layers, leaving 4-6 hours between dipping
- Cut out mold carefully

Paper

- Take paper and cut out specific shapes
- Fold to make 3D shells and glue together

Albanian Version

Side 1

Pse është bërja e qiriut e rëndësishme?

- Dylli ka qenë përdorur për shumë qëllime duke datuar që nga Egjiptianët e lashtë
- Dylli mund të shitet tre here më shumë se mjalti
- 20% e dyllit të tregëtuar përdoret për të bërë qirinj
- Qirinjtë e dyllit të bletëve qëndrojne më drejt dhe të pikojnë më pak sesa qirinjtë e parafinës
- Hapa të thjeshtë si shtimi I ngjyrës, zgjedhja e formave më të përpunuara mund t'i shtojë vlerë tregu qirinjve

RASP

Kontact
Rruga "Dritan Hoxha"
TeknoProjekt Building 2, ap28
PO Box 2415/1, 1001
Tirane, Albania

I gjithë informacioni është njerrë nga raporti "Value Added Products for Beekeepers in Albania" në të dhënat e projektit WPI. Për burime dhe referenca ju lutemi referohuni raportit plotë.

Ky udhëzues është përpiluar nga studentët e WPI, Daniel Cane, Meghan Dawe, Joseph Ostrowski, dhe Allison Rivard.

Për informacioni të mëtejshme ju lutemi referohuni udhëzuesi qiruit

WPI

Informacion për Bletarët për të bërë

Bërja e Qirinjve

Kjo broshurë diskuton bërjen e qiriut nga fillimi në fund, përfshirë pastrimin dhe ngjyrosjen e dyllit, krijimi I qirinjve të thjeshtë, dhe krijimi i kallëpeve të qiriut

Dhjetor 2014
Tiranë, Shqipëri

Pastrimi

- Për të pastruar dyllin përdor një bojler dopjo, një tenxhere të vogel mbi një tenxhere të madhe me ujë që valon
- Vendos dyll dhe ujë barabartë në tenxheren e vogël

- Derdh dyllin e shkrirë në një enë fleksibël
- Lëre të ftohet në tëmpëraturën e dhomës
- Hiqe bllokun e dyllit dhe kruaje nga mbeturinat
- Vazhdo deri sa të arrish pastërtinë e dëshiruar

Ngjyrosja

Natyrale

- Zgjidh barishtet me ngjyrën dhe aromën e dëshiruar

- Njeh dhe trazo dyllin dhe barishtet për 30 minuta
- Derdhe dyllin e shkrirë në një enë fleksibël
- Kruaje mbetjet e erëzave të ngurta nga fundi

Shkumës me Ngjyrë

- Për të shtuar ngjyrë përziej copat e shkumsit me ngjyrë me dyllin e shkrirë

Bërja e Qiriut

Koni

- Merr spango pambuku dhe lidhe në dyllin e shrirë për të bërë fitil
- Kridhe në dyll deri sa të arrish trashësinë e dëshiruar
- Fakultative
  - Përdor peshë në fund
  - Zhyte në ujë që të ftohet më shpejt

I mbështjellë

- Formo shtresa të holla dylli, si shtresa krijimi
- Mbështilli përrëth një fitili

Kavanozi

- Derdhe dyllin e shkrirë në kavanoza qelqi me fitilin e zhytur në dyll
- Mbaje fitilin drejt

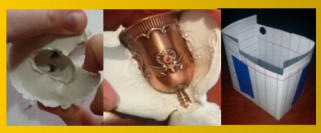
Formimi i kallëpit

- Bëj një kallëp (udhëzimet në faqen tjetër)
- Derdh dyllin e shkrirë në kallëp përreth fitilit dhe lëre të ftohet

Bërja e kallëpit

Gomë silikoni

- Bli gomë silikoni dhe material katalizator që shiten së bashku
- Gjendet në dyqane të veçanta hardware
- Hidhe gomën e silikonit në një mbajtës dhe përzieje me katilizator
- Vendose figurinën lart e poshtë në enë
- Lëre të forcohet dhe preje figurinën



Bërja e silikonit

- Bli material likuid për bërjen e silikonit
- Merr figurinën dhe zhyte në atë që ke bërë
- Krijo 8-10 shtesa, duke lënë një hapësire 4-6 orë nga zhytja
- Preje kallëpin me kujdes

Letra

- Merr letrën dhe preje në forma të vecanta
- Mbështille që të bësh guacka 3D dhe ngjiti sëbashku

Appendix I: Cosmetics Pamphlet

English Version

Side 1

Why are beeswax cosmetics important?

- Great for moisturizing skin
- Protects skin by creating a protective layer
- Beeswax is used in various cosmetic products such as creams, lotions, ointments, lip gloss, conditioners and many others.
- Beeswax has natural characteristics that make it irreplaceable

RASP

Contact
"Dritan Hoxha" Street,
TeknoProjekt building 2, ap.28
PO.Box 2415/1 , 1001
Tirana, Albania

office@rasp.org.al

All information was extracted from the report "Value Added Products for Beekeepers in Albania" on the WPI Project Database. For sources and references please refer to full report.

This guide was compiled by WPI students Daniel Cane, Meghan Dawe, Joseph Ostrowski, and Allison Rivard.

For more information please refer to the cosmetics guide.

WPI

Information for beekeepers to make

Beeswax Cosmetics

This pamphlet shows how to make three simple cosmetics with beeswax and other ingredients.

December 2014
Tirana, Albania

Side 2

Cleaning

- Cosmetic products require using thoroughly cleaned beeswax
- The double boiler method can be used
- Smaller pot goes over larger pot of boiling water

- Place equal wax and water in the smaller pot
- Pour melted wax into a flexible container
- Let cool at room temperature
- Remove block of wax and scrape off debris from bottom
- Repeat process several times or until beeswax is very clean

Required Materials

- Blender or stirring whisk
- 2 small cooking pots or sauce pans
- 1 larger pot
- Measuring cup
- A scale
- Small containers for storage

Lip Balm

- 4 tablespoons almond oil
- 2 tablespoons beeswax
- 2 vitamin E capsules

Procedure

1. Place beeswax and almond oil in small pot of double boiler until melted
2. After 3-5 minutes take pot out to cool and mix in vitamin E capsule
3. After mixing pour into container

Cold Cream

- ½ ounce beeswax
- 42 mL olive oil
- 15 mL water
- 1 vitamin E capsule

Procedure

1. Place the beeswax and olive oil in small pot of double boiler until melted
2. Warm the water in a separate pot
3. After 5 minutes take the pot out and add the warm water
4. Mix the ingredients, add the Vitamin E and pour into container

Moisturizing Lotion

- 40 mL coconut oil
- 87 mL almond oil
- 11 mL beeswax
- 38 mL aloe vera
- 79 mL water
- 2 vitamin E capsules

Procedure

1. Place beeswax and coconut oil into small pot of double boiler to melt
2. After melting, add almond oil and mix together
3. Take small pot out of double boiler and let it harden
4. Measure aloe vera and water in measuring cup
5. Slowly add ingredients to the hardened wax and oils
6. Mix the lotion for 10 minutes or until the same consistency and pour into container

Albanian Version

Side 1

Pse janë produktet kozmetike të dyllit të bletëve të rëndësishme?

- E mrekullueshme për lëkurë hidratuese
- Mbron lekurën duke krijuar një shtresë mbrojktëse
- Dyll i bletëve përdoret në produkte të ndryshme kozmetike si kremra, locione, shkëlqyes buzësh, kremra qetësues dhe shumë të tjera
- Dylli i bletëve ka karakteristika natyrale që e bëjnë atë të

RASP

Kontact
Rruga "Dritan Hoxha"
TeknoProjekt Building 2, ap28
PO Box 2415/1, 1001
Tirane, Albania

I gjithë informacioni është njerrë nga raporti "Value Added Products for Beekeepers in Albania" në të dhënat e projektit WPI. Për burime dhe referenca ju lutemi referohuni raportit plotë.

Ky udhëzues është përpiluar nga studentët e WPI, Daniel Cane, Meghan Dawe, Joseph Ostrowski, dhe Allison Rivard.

Për informacioni të mëtejshme ju lutemi referohuni udhëzuesi kozmetike.

WPI

Informacion për Bletarët për të bërë

Kozmetike me dyllin e bletëve

Kjo broshurë tregon sesi të bësh tre kozmetikë të thjeshtë me dyllin e bletëve dhe përbërës të tjerë

Dhjetor 2014

Tiranë, Shqipëri

Pastrimi

- Produktet kozmetike kërkojnë përdorimin tërësisht dyll blete pastër
- Mund të përdoret metoda e bolierit dopjo
- Tenxherja e vogël vendoset mbi tenxherene madhe me ujë që valon

- Vendos dyll dhe ujë barabartë në tenxheren e vogël
- Derdh dyllin e shkrirë në një enë fleksibël
- Lëre të ftohet në tëmpëraturën e dhomës
- Hiqe bllokun e dyllit dhe kruaje nga mbeturinat nga fundi
- Përsërite procesin disa here ose derisa dylli I bleëve të jetë shumë i pastër

Materiali i kërkuar

- Përzierës më lëvizje të shpejtë
- 2 xhezve ose tiganë të vegjël
- I tenxhere të madhe
- Filxhanin mates
- Një shkallë matëse
- Enë të flogla për ruajtjen

Baslam buze

- 4 lugë gjelle vaj bajame
- 2 lugë gjelle dyll bletësh
- 2 kapsula vitamin E

Procedura

1. Vendos dyllin e bletëve dhe vajin e bajames në një tenxhere të vogël mbi tenxheren e madhe deri sa të shkrijë
2. Pas 3-5 minuta nxirre tenxheren që të ftohet dhe përziej vitaminën E
3. Pasi i përzien hidhi ne enë

Kremi i ftohtë

- 1/2 ml dyll blete
- 42 ml vaj ulliri
- 15 ml ujë
- 1 kapsulë vitaminë E

Procedura

1. Vendos dyllin e bletëve dhe vajin e ullirit në një tenxhere të vogël mbi tenxheren e madhe deri sa të shkrijë
2. Ngroh ujin në tenxhere të ndara
3. Pas 5 minuta nxirre tenxheren dhe shto ujë të ngrohtë
4. Përziej përbërësit dhe vitaminën E

Locioni hidratues

- 40ml vaj arrë kokosi
- 87ml vaj bajame
- 11ml dyll blete
- 38ml aloevera
- 79ml ujë
- 2 kapsula vitamin E

Procedura

1. Vendos dyllin e bletëve dhe vajin e arres së kokosit në një tenxhere të vogël mbi tenxheren e madhe deri sa të shkrijë
2. Psi shkrin shto vaj bajame dhe perziej sëbashku
3. Nxirre tenxheren e vogël dhe lërë të forcohet
4. Mate aloe vera dhe ujin në filaxhaniin mates
5. Ngadalë shto përbërësit tek materiali i forcuar i dyllit dhe vajit
6. Përzieje locionin për 10 min dhe hidhe në enë

Appendix J: Propolis Guide

PROPOLIS

What is Propolis?

Propolis is a complex substance made up of beeswax and resins collected from plants, flowers and leaf buds. For this reason, every sample of propolis differs greatly based on the location of the hive and the surrounding plants varieties. The resins, which are collected when bees are foraging for nectar and pollen, are held on the bees' hind legs until it is transported into the hive.

Why is it Important?

Once in the hive, propolis plays a very important part in the health and safety of the entire colony. It is used to disinfect areas, seal unwanted gaps in the hive, and block entry points to keep out other insects.

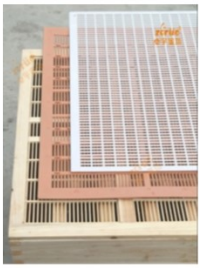
The most important way that propolis affects humans is in its medicinal uses. The resins found in propolis are made up of compounds known to have antibacterial, antifungal, antiviral, anti-inflammatory, antioxidant, and antitumor characteristics. These significant characteristics can be used in medicines once the propolis is converted into a usable form for humans.

The most common propolis product is a propolis tincture, which is normally around 30% propolis by weight and can be used to treat conditions like allergies, skin irritations, weakened immune systems, burns, and acne. Propolis tinctures can be a very profitable source of income from a beehive if produced properly.

Extraction

Using Propolis Traps

The most efficient way to collect larger amounts of pure propolis is to use a trap. These mesh, metal or plastic lattices seen on the right go in the top of langstroph hives for honeybees to fill the gaps with propolis. As propolis is not collected, not created by the bees, the extra collection of propolis from these traps does not harm or adversely affect the honeybees. Once filled, these traps can be frozen to remove the propolis more easily.



Using Hive Tool

While traps are ideal for collecting propolis, it can also be scraped off of the hive as seen to the right. However, this takes more time and also results in a less clean propolis sample.

Dissolution

One of the biggest challenges with dissolving propolis is the amount of time it takes. Currently, most beekeepers use ethanol as their solvent for dissolving propolis, which takes anywhere from 3 weeks to a month to fully dissolve, depending on the concentration of ethanol. Here are some ways to reduce the dissolving time.

Dissolving Solvent

The ideal solvent should be capable of breaking down substances of different chemical composition, such as polar and nonpolar, like the beeswax and plant resins that make up propolis. It also must be safe for humans to ingest and apply to skin.

Surface Area

Maximizing the surface are of propolis will increase the dissolving efficiency and decrease the time to dissolve. In other words, propolis needs to be in the smallest pieces possible. Grating frozen propolis is the most effective way to do this but it requires a lot of effort. Other suggestions have been taking large pieces of frozen propolis and ripping them apart or breaking them up with a hammer.

Cleaning

Propolis should be clean and free of debris such as dead bees, wood shavings, and large amounts of wax. If propolis appears to have excessive undesirables, then it can be soaked in water so that those impurities will float and can be easily removed. It can also be heated to remove the debris. However, these cleaning steps decrease the beneficial qualities of propolis and should be avoided whenever possible.

Alternative Solvents

Common Solvents

Ethanol is the most common used solvent for dissolving propolis. This process takes a long amount of time and is often done without specific proportions. Propylene glycol is an alternative although it needs higher temperatures which can often denature some of the active ingredients in propolis.

Raki

Some beekeepers use *raki* instead of highly concentrated ethanol due to its availability and low cost. *Raki* has a low alcohol content of normally 40% by volume in comparison to stock solutions of ethanol so it is much less effective. This solution in non-ideal can be a low cost option if obtained at higher concentrations.

Mixture of Ethanol and Olive Oil

We tested a solution of equal parts of extra virgin olive oil and 96% ethanol for its ability to dissolve propolis. The rate of dissolving propolis with this solution was comparable to a standard 96% ethanol solution. This process would reduce the quantity of expensive high grade ethanol without decreasing the rate of dissolving. Although more tests need to be done on the exact amount of time our alternative takes to dissolve propolis, it has the potential to be a more cost effective method.

Diethyl Ether (DISCLAIMER – volatile, combustible, flammable)

Diethyl ether is a very effective solvent for propolis. It can dissolve propolis in a very short amount of time. It is possible that diethyl ether could be used to dissolve propolis and then could be evaporated and replaced with ethanol. However, the safety concerns of this process, safe exposure limits for humans and effect on the chemical components of propolis still need to be investigated further.

Filtration

At the end of any dissolving process, the solutions must be filtered to remove any impurities. When the propolis solution is ready to be filtered, separate containers for the extract must be prepared with the filter material secured over the opening. Then you can slowly pour the propolis solution onto the filter material.

Once the mixture has been completely filtered and the filter material contains only the propolis and debris, the exact amount of dissolved propolis can be determined. The sample on the filter material should be left overnight to dry before it is weighed to obtain an accurate weight. The concentration of propolis extract is now the weight that was dissolved (the initial amount added minus the solid filtered out), divided by the weight of the solvent used.

Diluting a Tincture

Propolis tinctures are the ethanol solutions of propolis that have been diluted so that the alcohol level is reasonable for human use. The first step in converting a propolis solution to a tincture is demining the propolis concentration. Then you can allow some of the ethanol to evaporate. If you add the same amount of water as the ethanol lost to evaporation, the ethanol concentration will be halved while the propolis concentration will remain the same thus making it more useable for humans. Varying amounts of alcohol evaporation and water dilution can be used to vary the composition of the solution depending on its final use.

If the solvent used was solely ethanol, the tincture can be used on the skin or in the body. If the solvent was a combination of ethanol and olive oil, the tincture is more suitable as an ingredient in cosmetics or for treatment of skin conditions.

All information was extracted from the report "Value Added Products for Beekeepers in Albania" on the WPI Project Database. For sources and references please refer to full report.

This guide was compiled by WPI students Daniel Cane, Meghan Dawe, Joseph Ostrowski, and Allison Rivard.

Appendix K: Candles Guide

CANDLE MAKING

Melting wax in a double boiler system to clean.

Different shades of wax from due to cleaning.

Removal of debris that had settled after melting down and cooling wax.

Why Candles?

- Wax has been used for many purposes dating as far back as the ancient Egyptians
- Wax can be sold for 3 times as much as honey
- 20% of traded wax is used for creating candles
- Beeswax candles stand straighter and drip less than paraffin candles
- Simple steps such as adding color of choosing more elaborate shapes can add market value to candles.

Cleaning

When wax is extracted from the hive, especially in the later summer and fall, it often contains unwanted particles such as propolis, dirt, and even bee remains. Here's a simple way to clean your wax.

1. Place equal amounts of wax and water in the top portion of a double boiler. This can be a small pot, a jar, or a can. The bottom portion of the double boiler should have boiling water.
2. Heat until the mixture is liquefied and pour into another container. Stir slowly to avoid aerating the wax and adding unwanted bubbles. If possible, that container should be flexible, such as a Tupperware or plastic food container.
3. Let cool at room temperature. Do not place in refrigerator or ice box as the debris will be more difficult to remove.
4. After the wax has hardened completely, remove the block of wax and discard the water. Do not pour the water down a drain as the wax can clog the drain.
5. Take the block of wax and scrape off the darker layer of wax and debris from the bottom.
6. Repeat this process until the wax block is of a desired cleanliness and color.

Coloring

Colored wax can make for more appealing and diverse selections of wax products. You can color your wax with natural materials or crayons.

Natural

1. Choose herbs with a desired color and scent for your candle.
2. Add the herbs to the wax and water when it is being heated in the double boiler. Stir gently for approximately 30 minutes
3. Repeat Cleaning steps 2-6.

Crayons

1. Mix crayon pieces in with melted wax in the double boiler and stir for 15 minutes. Water is not needed.

Tapered Candles

are very common and have numerous used from religious ceremonies to lighting the dinner table. Here is how you can make a tapered candle at home.

1. Find some cotton string or twine, approximately 1mm thick. This will be your candle wick
2. Melt wax in a pot that is as tall as your desired candle height
3. Dip the wick into the pot and remove. Make sure to straighten the wick at this point.
4. Continue to dip the wick in the wax until the candle is the desired thickness. Allow time to cool in between dips. 15 dips will yield a candle with a diameter of approximately 2cm.
5. Optional
   a. Use weight at the bottom of the wick to ensure the candle is straight.
   b. Dip candle in cold water between dips in the wax to speed up the cooling process.

The hexagonal sheets are colored foundation sheets. These can be rolled into simple candles as seen.

Rolled Candles *are often made of hexagonally patterned foundation sheets which give them a distinct character. Making them is easy!*

1. Take your cotton string or twine that is about 1mm thick and dip it in melted wax. Straighten the string as it will serve as the wick.
2. Obtain a thin sheet of wax, such as those used for foundation sheets.
3. Cut the sheet of wax so it is the higher of your desired candle. This sheet can be a rectangle or a triangle depending of the candle shape.
4. Place the wick at the edge of the wax sheet and roll the wax tightly around the wick.

Jar Candles *are simple to make and fun to decorate for any occasion.*

1. **Find a jar that is the desired size of the candle**
2. Take your cotton string or twine that is about 1mm thick and dip it in melted wax.
3. Place the wick vertically in the jar so that the wick touches the bottom. You can hang the wick from top of the jar by placing something thin across the opening of the jar.
4. Pour melted wax in the jar.
5. Decorate the outside of the jar for special occasions.

Silicone rubber mold made from listed procedure.

Silicone Rubber *candle molds are durable, versatile, and easy to use.*

1. Purchase silicone rubber material with catalyst. This can be found in select hardware stores and will be sold in two parts. Approximately 8000 Lek per kilogram.
2. Mix two components in a separate container. If you use a quarter of the silicone, use a quarter of the catalyst, and so forth
3. Find a shape or figurine for the candle. This can be something plastic, wooden, metal, or even a hard fruit or vegetable. The figure can be details but should not have any large protrusions.
4. Pour the mixture into a container that is just larger than the candle shape.
5. Place the shape upside down in the container so that the bottom of the figuring is at the surface.
6. Let harden for about 24 hours and carefully cut a slit to remove the figurine. Using a thin sharp object, stab a hole through the silicone mold where the wick should come out.

An example mold using this procedure is shown in the first picture to the left.

This candle was made from a silicone caulking material mold. The simple mold was created using the listed procedure.

Silicone Caulking *can be used as a substitute for silicone rubber. Although this material is less versatile and produces lower quality molds in comparison to silicone rubber, it is much more affordable for beekeepers.*

1. Purchase silicone caulking material. This can be found in various hardware stores and costs approximately 500 Lek per kilogram.
2. Find a shape or figurine for the candle. This should be a relatively smooth shape without deep ridges or even minimal protrusions.
3. Dip the figurine into the caulking and allow to air dry.
4. Continue to dip until at least 10 layers have been created, leaving 4-6 hours between dipping.
5. Carefully cut out the mold and remove the shape. Using a thin sharp object, stab a hole through the silicone mold where the wick should come out.

Paper *candle molds are actually sturdy enough to hold melted wax and can be used to make a variety of simple geometric shapes*

1. Cut a piece of paper and fold to make a 3D shell. This can be as simple as a rectangular prism or as advance as a 12 sided shape. Folded stencil shapes used to make candles can be seen to the right.
2. Glue the shape to seal all of the edges.

This is how a 3D printed mold is created and filled with wax to create a final candle.

3D Printed *molds sounds high tech, but they are actually an easy and inexpensive way to make candle molds*

1. Find a design online for a mold in an online blue print library or create one using computer software.
2. Use a 3D printer and your design for create a one or two piece candle mold.

How does it work?

A 3D printer uses computer software to layer sheets of hot plastic. The plastic cools quickly and the shape becomes hard and durable.

RASP

WPI

All information was extracted from the report "Value Added Products for Beekeepers in Albania" on the WPI Project Database. For sources and references please refer to full report.

This guide was compiled by WPI students Daniel Cane, Meghan Dawe, Joseph Ostrowski, and Allison Rivard.

Appendix L: Cosmetics Guide

COSMETICS

Why are beeswax cosmetics important?

- Beeswax is great for moisturizing the skin
- Protects the skin by creating a protective layer
- Beeswax is used in various cosmetic products such as creams, lotions, ointments, lip gloss, conditioners and many others.
- Beeswax natural characteristics make it irreplaceable

Cleaning

When wax is extracted with the hive, especially in the later summer and fall, it often contains unwanted particles such as propolis, dirt, and even bee remains. Here's a simple way to clean your wax.

1. Place equal amounts of wax and water in the top portion of a double boiler. This can be a small pot, a jar, or a can. The bottom portion of the double boiler should have boiling water.
2. Heat until the wax is liquefied and pour into another container. Stir slowly to avoid aerating the wax and adding unwanted bubbles. If possible, that container should be flexible, such as a Tupperware or plastic food container.
3. Let cool at room temperature. Do not place in refrigerator or ice box as the debris will be more difficult to remove.
4. Remove the block of wax and discard the water. Do not pour the water down a drain as the wax can clog the drain.
5. Take the block of wax and scrape off the darker layer of wax and debris from the bottom.
6. Repeat this process until the wax block is of a desired cleanliness and color.

Required Materials

- Blender or stirring whisk
- 2 small cooking pots or sauce pans
- 1 larger pot
- Measuring cup
- A scale
- Small containers for storage

Lip Balm

Almond oil, one of the core ingredients in lip balm, has rich acids that help cross the skin barrier on the lips to stop inflammation. Lip balm old has antioxidant characteristics due to the vitamin E content. Lip balm is simple and quick to make but ingredients can be expensive. Lip balm is a good option if you have minimal wax to use from your apiary as it can be sold in small quantities.

Ingredients

- 4 Tablespoons almond oil
- 2 Tablespoons beeswax
- 2 Vitamin E capsules

Procedure

1. Place beeswax and almond oil in small pot of double boiler until melted
2. After 3-5 minutes take pot out to cool and mix in vitamin E capsule
3. After mixing pour into container

Cold Cream

Cold Creams have been used since the second century for its cooling effect on the skin when water is evaporated. They contain simple ingredients that make it economically feasible. If you do not have access to specific oils and ingredients, cold creams contain very accessible ingredients. Borax can be added to the water components during the heating process to help thicken and preserve the cream.

Ingredients

- ½ ounce beeswax
- 42 mL olive oil
- 15 mL water
- 1 Vitamin E capsule

Procedure

1. Place the beeswax and olive oil in small pot of double boiler until melted
2. Warm the water part in a separate pot
3. After 5 minutes take the pot out and add the warm water
4. Mix the ingredients and add the Vitamin E and pour into container

Measuring and Mixing Techniques

Displacement
When small samples of wax are needed, scales that are sensitive enough are often very expensive. One ounce of beeswax solid is equivalent to one fluid ounce of beeswax. Therefore, drop wax into a set quantity of water and the displacement in ounces is the weight in ounces of the wax.

Oil vs Water
Oil and water components need to be heated and mixed separately to more easily combine the polar and nonpolar components.

Vitamins and essential oils
Vitamins and essential oils should be added after the remaining components have been removed from heat as the heat can degrade the beneficial effects of the additives.

Removal of debris that had settled after melting down and cooling wax.

Moisturizing Lotion

Although moisturizing lotion requires many steps and more expensive ingredients, they can be a very profitable product. A blender can be used during the mixing process. However, rapid hand mixing for 10-15 minutes is sufficient for the final product. More advanced materials such as rose water, which act as a soothing agent, can be exchanged with water to make a higher value lotion.

Ingredients

- 40 mL coconut oil
- 87 mL almond oil
- 11 mL beeswax
- 38 mL aloe vera
- 79 mL water
- 2 vitamin E capsules

Procedure

1. Place beeswax and coconut oil into small pot of double boiler to melt
2. After melting, add almond oil and mix together
3. Take small pot out of double boiler and let it harden
4. Measure aloe vera and water in measuring cup
5. Slowly add ingredients to the hardened wax and oils

RASP

WPI

All information was extracted from the report "Value Added Products for Beekeepers in Albania" on the WPI Project Database. For sources and references please refer to full report.

This guide was compiled by WPI students Daniel Cane, Meghan Dawe, Joseph Ostrowski, and Allison Rivard.

Appendix M: References for Pictures Used in Pamphlets and Guides

Alxpril. (2013). 3D Printed Candle Mold. Retrieved from http://www.instructables.com/id/3D-Printed-Candle-Mold/

Beeswax. (n.d.). from http://healthywithhoney.com/beeswax/

Beeswax with a Twist. (n.d). from http://www.candlemaking.com.au/WebRoot/ecshared01/Shops/candlemaking/4CC7/FC5D/32E6/F38F/E944/C0A8/D240/D48C/beeswax_with_twist_2.JPG

Cane, D., Dawe, M., Ostrowski, J., & Rivard, A. (2014). Value Added Beekeeping Products Experiments. from http://s48.photobucket.com/user/iqpbees14/slideshow/

Degraeve, K. (2013). Geometric Candles. Retrieved from http://howdidyoumakethis.com/geometric-candles/

DevonBeekeepers'Association. (2011). Hive products- Propolis. http://www.devonbeekeepers.org.

Fisher, D. (n.d.). How to Make Dipped Taper Candles. Retrieved November 16, 2014, from http://candleandsoap.about.com/od/basicinstructions/ss/How-To-Make-Dipped-Taper-Candles.htm

Honeybee with Raw Propolis. (n.d.). Retrieved from https://c1.staticflickr.com/3/2848/9439586846_c79e426726.jpg

Honeycomb. (2014). from http://en.wikipedia.org/wiki/Honeycomb

jessyratfink. (n.d.). Easy homemade coconut and beeswax lip balm. from http://www.instructables.com/id/Easy-homemade-coconut-and-beeswax-lip-balm/

Picture of Propolis Extract. (n.d.). Retrieved from https://c1.staticflickr.com/9/8231/8485153235_1697a4fe7e_z.jpg

Propolis. (n.d.). from http://www.bees-products.com/?p=propolis

Propolis Traps. (n.d.). Retrieved from http://g02.s.alicdn.com/kf/HTB1bQ7WFVXXXXXFXpXXq6xXFXXXB/200673940/HTB1bQ7WFVXXXXXFXpXXq6xXFXXXB.jpg

Raw Propolis. (n.d.). Retrieved from http://upload.wikimedia.org/wikipedia/commons/a/a1/Propolis_1.JPG

Shaw, M. L. (2013). Making Beeswax Candles with Molds. Retrieved from http://www.motherearthnews.com/homesteading-and-livestock/making-beeswax-candles-zbcz1312.aspx - axzz3LQ8wonqw

Yellow Beeswax Chunks. (2014). from http://www.stakich.com/yellow-beeswax-chunks.html