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The Medicinal Plants in the Maltese Islands and their Ethnoveterinary aspects

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Budapest, Hungary
2021

Table of contents:

1. Introduction:

In my review, I speak about the relevant medicinal plants that can be found in the Maltese Islands and their ethnoveterinary aspects. The field of medicinal plants is a large and diverse one but the level of research in certain countries is lacking, the Maltese Islands being one of them. I think the world in general is appreciating the use of natural remedies more and more as time goes by. In today's society, most pets are considered part of the family, deserving the level of treatment deemed appropriate for humans. For this reason, many owners are tempted to use herbal remedies to treat their animals and these studies are important to ensure that these plants are identified and used correctly, not only for pet owners but also to raise awareness among the veterinary profession.

The reason this topic intrigued me is because I believe our country's environment is underestimated by many and in my opinion, there is so much flora and fauna which are unappreciated, but they really have a lot to offer. I wanted to highlight the medicinal benefits of some very well-known local plants which are commonly used by the Maltese, mostly in cuisine. The aim of this study is to select a few plants, describe their physical appearance, look back to the ethnoveterinary uses of these plants in different countries around the world and identify the active constituents they possess. All this information will indicate the possible traditional uses of these plants in Malta.

Another factor which highlights the importance of this field of study is the use of these medicinal plants in developing countries. Given the situation, many countries simply do not have access to any form of treatment and so are limited to the resources found in their surroundings. They are also highly dependent on their livestock, so for them, researching all aspects of these plants enables them to better select a specific plant that targets the condition they are dealing with.

Furthermore, these natural products are environmentally friendly. Being an environmentalist, I really appreciate the use of natural products and the benefits that come with them. It is therefore important to investigate the less harmful effects of natural remedies and increase our knowledge pool of other alternatives over time.

2. The importance of Medicinal plants:

Ethnoveterinary Medicine (EVM) takes into consideration the traditional practices of veterinary medicine with the objective of validating them. It is related to Veterinary Anthropology, which is the study of how animal health and animal illnesses have affected society and its culture over the years. So EVM investigates the well-known and established practices of animal healthcare used most among livestock in the past, with the purpose of maintaining a healthy herd to sustain the human population. The most common field of EVM is the application of medicinal plants. For this reason, EVM goes hand in hand with ethnobotany, which is the study of society's traditional knowledge of plants and their uses.

Medicinal plants are a type of Phytotherapy, along with a few others such as, Aromatherapy, Homeopathy and Traditional Chinese medicine (TCM). A medicinal plant is defined as a plant, or part of it, which contains one or more substances that may be used for therapeutic purposes or are precursors to the synthesis of these substances. These plants are used with the intention to prevent or cure medical conditions or diseases, as a stand-alone treatment or even as a supportive treatment. All vegetation is equipped with several natural chemicals with the function of supporting growth and development of the plant as well as providing defence mechanisms which protect them from predators. They contribute to the natural nutrient cycling in the soil through decomposition and recycling of nutrients. The properties which make these plants medicinal were discovered a long time ago and have benefitted medicine practices since prehistoric times. Back then, the exact substances and their effects may not have been known, yet they were able to establish a good foundation to put these plants to good use. This knowledge was passed down through generations and documented over the years and we are now aware of many of these characteristics. One plant may contain several medicinal substances in various parts of the plant's anatomy and so different parts of the same plant could possibly have different effects. Phytochemistry is study of chemicals derived from plants, this field helps explain the substances and their effects and so does The Medicinal Plant Transcriptomics Database, through the collection of genetic background of these plants.

Towards the middle of the 20th century, the use and development of these traditional practices started to decrease because at this point, research projects shifted to explore the development of synthetic chemicals. However, plants have always been a crucial aspect of medicine, in fact, a good number of drugs available on the market now are derived from

medicinal plants. They are effective, they are chemically balanced, and they also are less injurious with minimal side effects (Khan et al., 2019).

Although they are viewed as being very safe, the World Health Organisation (WHO) and other organisations, emphasise the importance of identification of these plants to ensure that they are used for the correct indications, for the intended species and given at the appropriate dosages. This will prevent toxicity caused by defective selection. The WHO puts together monographs to provide all the necessary information about the adequate medicinal plants, including descriptions of their appearance, constituents and their effects, indications, dosages, efficacies, safety precautions and contraindications. This information is shared worldwide and updated regularly for the benefit of anyone intending to use these plants (Ernst, 2010).

Part of the reason for the creation of this monograph is the fact that there are thousands of plants species, many of which are said to have medicinal properties. In 2002, the Food and Agriculture Organisation (FAO) determined that from an estimation of a total of over 420,000 plant species worldwide, over 50,000 of them are used for medicinal purposes. (Cunningham et al., 2021).

Another agency, aside from WHO, is the Committee on Herbal Medicinal Products (HMPC) which forms part of the European Medicines Agency (EMA) and is responsible for the investigation into the scientific data of these plant-derived substances and their preparations (Knöss and Chinou, 2012). This is done in accordance with the following regulations:

- Regulation (EC) no 726/2004 which speaks about the authorisation and supervision of the medicinal products for human and veterinary use and establishing a European Medicines Agency.
- Council Directive 2004/42/EC, together with the Directive 2001/83/EC, which speaks about the traditional herbal medicinal properties and medicinal products.

These enable harmonisation of the safe use of herbal medicinal products in the European Union (Committee on Herbal Medicinal Products (HMPC) - European Medicines Agency, 2021).

The increasing level of drug resistance, particularly antimicrobials, is resulting in the restricted use of several drug classes. It is therefore essential, now more than ever, to take advantage of the several medicinal plants that have been shown to exhibit antimicrobial effects. Apart from expanding our pharmaceutical range, a study has shown that some compounds found in medicinal plants may even reverse drug resistance (Hayes et al., 2019).

Aside from public and veterinary health, medicinal plants are an extremely important factor in environmental protection and sustainable development.

Despite the usefulness of medicinal plants, there are a few critical factors that one must be aware of. Most herbal remedies are considered safe. However, one must follow the guidance of a reliable source before attempting any form of herbal treatment, must identify the plant correctly to ensure it is the one they intend to use and must be careful to use it on the species if was prescribed for. The latter is often neglected when owners try to apply human approved herbal remedies to their pets. These important factors ensure that the active constituents of these plants are not poisonous or harmful in any way to the animal, that they are not contraindicated and do not interact negatively with other drugs (Nasri and Shirzad, 2013).

3. Active constituents of Medicinal plants

Like any other organism, several processes take place inside the cells of a plant to provide it with the chemicals it requires to survive. Plants undergo a process of respiration which may be defined as the production of energy. This process encompasses several steps which collectively may be referred to as the primary metabolism. This is a very intricate and complex system but consists of the following main steps. Firstly, Photosynthesis occurs, this is the use of light, carbon dioxide and water for the production of nutrients, in particular oxygen and glucose by means of the Calvin cycle. Glucose is a hexose monosaccharide which then undergoes glycolysis, a process by which it is converted into a compound called Pyruvate. Pyruvate is then oxidised to produce Acetyl-CoA. Both these compounds, Pyruvate and Acetyl-CoA can enter another cycle called the Tricarboxylic acid cycle (TCA Cycle), also known as the Krebs cycle or the Citric Acid cycle. Through a series of steps, this cycle generates and makes available the energy required by the plant. These sequences of events are shown by the black boxes Figure 1.

As a result of the primary metabolism, secondary metabolites are produced. The biosynthetic pathways are composed of several constituents which are responsible for the herbal effects found in plants. These are the reason we can refer to a plant as being ‘medicinal’. Some of the major secondary metabolites include saccharides, phenoloids, polyketides, terpenoids and azotoids. Figure 1 shows the main parts of these pathways, highlighting the constituents of relevance to us.

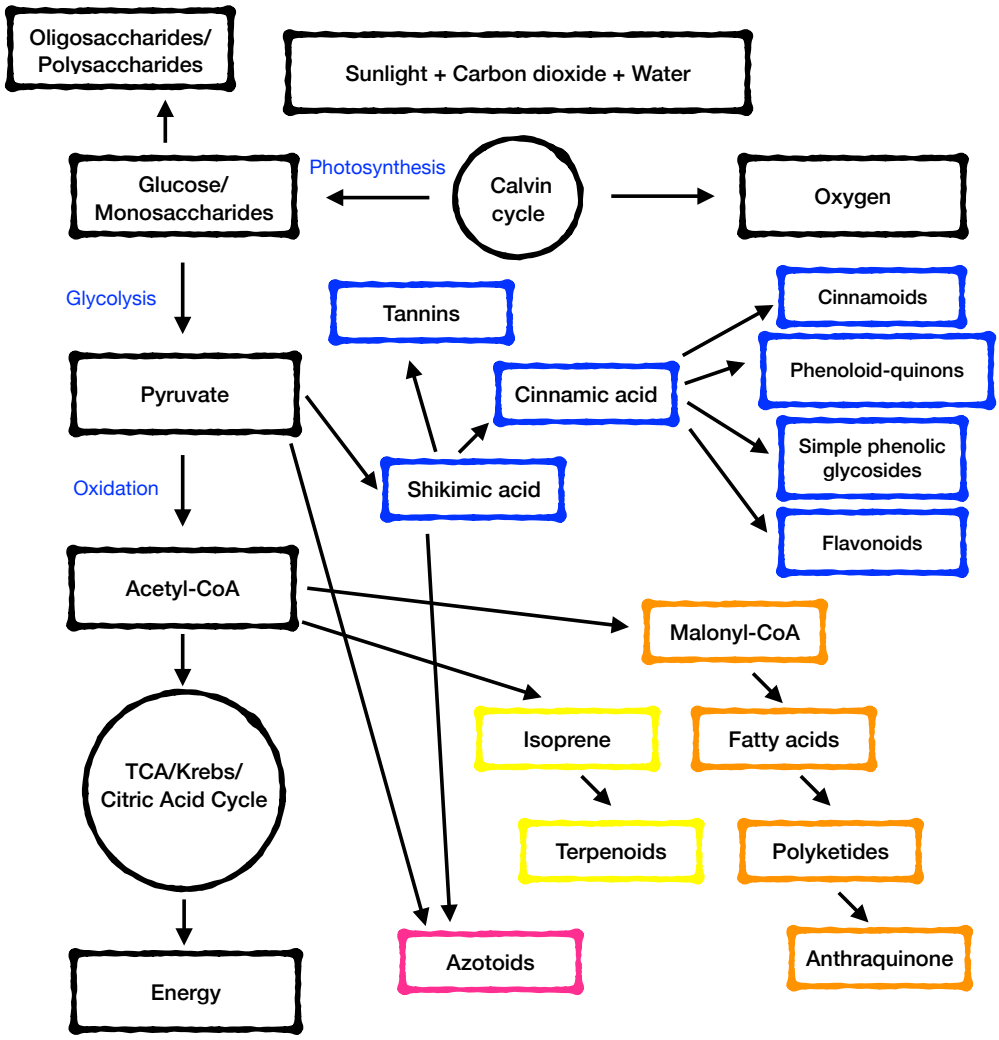


Figure 1: The main components of the Primary and Secondary metabolism of plants

The saccharides component refers to the production of sugars, which include monosaccharides, oligosaccharides, and polysaccharides. These are known to influence the respiratory system, to have a purgative effect, for being a diuretic as well as being an anti-inflammatory. *Verbascum phlomoides, Linum utilissimum* and *Echinacea angustifolia* are examples of plants in this group.

Phenoloids production, represented by the blue boxes in Figure 1, which starts from Pyruvate. This pathway involves the production of shikimic acid which produces cinnamic acid and tannins. Shikimic acid may then be converted into a few different groups of compounds, including Cinnamoids, Phenoloid-quinons, Simple phenolic glycosides and Flavonoids. Tannins have several effects including anti-bacterial and anti-viral effects, anti-haemorrhagic and detoxifying effects. Cinnamoids in general have anti-fungal, anti-

microbial, anti-tumour and hepatoprotective effects. It also helps with gastrointestinal conditions, has a sedative effect and is spasmolytic. Some effects of Simple phenolic glycosides are analgesia, anti-pyretic and anti-inflammatory. Flavonoids are proven to have anti-bacterial, anti-fungal, anti-inflammatory, and anti-cancer effects. They also have cardiovascular effects. *Cinnamomum zeylanicum, Ginkgo biloba,* the *Crataegus* spp, the *Tilia* spp are examples of the plants in this group.

Another group of secondary metabolites in plants is polyketides, represented in Figure 1 by the orange boxes. The production of these is initiated from Acetyl-CoA. The main effects in this group include anti-helminthic, anti-bacterial and spasmolytic effects. *Cassia Senna* and the *Aloe* spp. are examples of plants in this group.

Terpenoids is another major secondary metabolite, shown by the yellow boxes in Figure 1, also occurring from the production of Acetyl-CoA. The products may be mono-, di- or sesquiterpenoids and give way to the production of triterpenoids, tetraterpenoids, polyterpenoids, steroids and saponins. This group is considered to have anti-bacterial, appetite enhancing, anti-spasmodic, expectorant, diuretic, and sedative effects. *Melissa offinicalis, Lavandula angustifolia, Salvia officinalis, Cinnamomum camphora* as well as the *Rosa* spp. and the *Mentha* spp. are examples of the plants in this group.

The last metabolites are Azotoids, which include the production of alkaloids, cyanogenic glycosides and glucosinolates. *Capparis spinosa, Verbena officinalis* and *Nicotiana glauca* are examples of plants in this group.

4. Ethnoveterinary Medicine aspects:

4.1 Ethnoveterinary Medicine aspects of medicinal plants worldwide:

The benefits of medicinal plants were discovered hundreds of years ago. The use of these plants in the present day varies greatly, depending on the country in question. The western world has a highly developed set of synthetic chemicals which are very effective and collectively, cover the vast majority of diseases. For this reason, herbal remedies tend to be less sough after and perhaps side-lined unintentionally. However, the use of natural products, including therapeutic herbal remedies are increasing in popularity again.

Medicinal traditions have been passed down from generation to generation by word of mouth and it had not been documented much until quite recently. A study done in Brazil, shows that the natives have great trust in these traditional practices, when compared to modern medicine treatments since they are easily accessible and have been used successfully for hundreds of years now. The most common conditions treated there with medicinal plants are diarrhoea, skin lesions, parasites, and wounds, among other minor ones (Monteiro et al., 2011). In Canada, medicinal plants are used mostly by livestock farmers, mainly to try to decrease the cost of allopathic drugs or in cases where they are not allowed to use them, such as in organic farming (Lans et al., 2007). In Trinidad and British Columbia, many medicinal plants are used to treat racehorses and these practices are very developed specifically for equine. These two countries are linked in location but also in their history and thus, there are several shared traditions (Lans et al., 2006).

On the other hand, developing countries may not have unlimited access to synthetic substances and so it is evident that they have had to and still must maintain the use of herbal remedies to treat their livestock and most likely, themselves too. Countries suffering from poverty or reduced resources are forced to use what is available to them. This may be due to the lack of available veterinary services or the inability of the people to pay for them. This occurs in varying degrees depending on the country in question. Several of these countries still use the practices passed down to them from their elders and are being documented as time goes on.

In Sub-Saharan Africa and other countries in a similar situation, conditions do not allow for conventional medicine and given the level of poverty as well as the high level of dependence the population has on its livestock, traditional practices prevail enormously (Eiki

et al., 2021). In Botswana, farmers rely on ethnoveterinary medicine to treat their livestock, for the simple reason that most of them cannot afford synthetic medicines (Dikeme et al., 2010). In Cameroon, medicinal plants and their role in animal healthcare is of utmost importance. There is no concept of veterinary public health and no support from governmental bodies, except for diseases with zoonotic potential. Therefore, traditional herbal remedies are their main source when it comes to treating animals (Dzoyem et al., 2020).

In India, the ethnoveterinary practices date back to as early as 1500 BCE. Cattle husbandry was advanced even back then, and the cow was a highly adored species and considered to be a sign of wealth. This therefore led to the development of herbal medicine among cattle, and to a lesser extent, horses. These practices are still used for basic first aid in India, especially for livestock in very rural areas (Bhatt et al., 2019). In certain parts of China, the people's livestock is still a major part of their livelihood and income, so traditional remedies are still very much in use (Qian et al., 2010). There is another type of Phytotherapy associated with the Chinese. This is Traditional Chinese medicine (TCM). The use of herbal products is one approach, acupuncture and tai chi are others. This is a concept which aims to target areas called 'meridians', through which substances are said to flow to keep the body healthy. The herbal products have sometimes resulted in improvements however not consistently. Despite many studies, the effects they claim to achieve have yet to be scientifically proven. The safety of this type of medicine is questionable as there have been contaminants included into these preparations which have led to serious side effects.

There are several medicinal plants which are widely used all over the world for human use. These include the Ginkgo/Maidenhair tree (*Ginkgo biloba*), Turmeric (*Curcuma longa*), Evening primrose (*Oenothera biennis*), Flax (*Linum usitatissimum*), Tea tree (*Melaleuca alternifolia*), Coneflower (*Echinacea angustifolia*), Lavender (*Lavandula angustifolia*) and Chamomile (*Matricaria chamomilla*). Turmeric is also common in veterinary medicine, alongside True Aloe (*Aloe vera*), Milk thistle (*Silybum marianum*), Hawthorn (*Crataegus monogyna*), Dandelion (*Taraxacum officinale*) and Sweet wormwood (*Artemisia annua*). These are just a few examples of commonly used medicinal plants. Aside from the ones mentioned in this review, none of the above plants are native to the Maltese Islands and if present, are cultivated or alien species.

4.2. Ethnoveterinary Medicine aspects of medicinal plants in Europe

Like the rest of the world, the use of medicinal plants for animal healthcare is a common tradition in Europe and has been passed down over time. The Mediterranean is known for its diverse range of plants with approximately 25,000 native species. It is estimated that more than 50% of these plants are endemic to the Mediterranean region. Several of the plant species have been used to produce pharmaceuticals as well as in other fields, such as for cosmetic production.

In the Mediterranean area, certain countries have managed to sustain the traditional medicinal practices. Countries like Spain and Portugal have a great number of potential ailments for the most common disease. Even though synthetic drugs are produced and dominate modern medicine, the use of herbal remedies is often also offered as supportive treatment (Farinha et al., 2012).

In Switzerland, the use of medicinal plants for the treatment of livestock diseases has been maintained by most of the farmers. When the synthetic medicines increased in popularity, the farmers did not abandon these traditions and now that the benefits of certain herbal remedies are being resurrected, the country is relying on these farmers to share their knowledge and contribute to the progression of traditional medicine (Mertenat et al., 2020).

In Israel, it was found that a very small number of people have knowledge of medicinal plants in their country. They are greatly concerned that since these traditions are not common practice, they will die out completely, without any record of them left for future generations. In fact, this country is desperately trying to discover the aspects of ethnoveterinary medicine which was part of their culture and had been common practices among their ancestors (Landau et al., 2014).

Estonia have been exemplary when it comes to the collecting and recording of ethnoveterinary medicine. Their cattle rearing in this country was developed during the Bronze Age, meaning as early as 1800 BC and this is perhaps the reason that traditional methods of treatment have been documented since the twentieth century (Kalle and Kass, 2020).

In Serbia, it was found that the level of knowledge of medicinal plants was severely lacking, even among inhabitants in rural areas. Studies are currently underway to gather and document these traditions (Marković et al., 2021).

5. Ethnoveterinary Medicine aspects of medicinal plants in the Maltese Islands

Malta is an archipelago, called the Maltese Islands, and is in the centre of the Mediterranean Sea, located between Sicily and the continent of Africa. With an area of 316km squared, it is one of the smallest countries in the world. The Maltese climate is a typical Mediterranean one, consisting of hot dry summers and mild wet winters. The climate, as well as soil conditions, will both contribute to the success of habitats. Maltese soil is high in calcium carbonate, has a high pH of higher than 8 and a high clay content but is low in organic matter.

There are four main habitats present in the Maltese islands which appear in different stages of ecological succession, namely Steppe, Garrigue, Maquis and Woodland. (Terrestrial Habitats - ERA, 2021). The flora present on the Maltese Islands is distributed among these habitats in the following proportions, 40% grows on disturbed or arable land, another 40% on rocky ground while the remaining 20% spread over more specific habitats such as cliffs, marches, and beaches (Terrestrial Habitats - Nature Trust - FEE Malta, 2021). In 2019, the Maltese Islands had just under 70,000 livestock animals, 52% were pigs, 20.5% were cattle, 19.3% sheep and 8.2% being goats. Most of these animals are found in the main island of Malta. With large amounts of animals, given the area of the country, a large part of the arable land is used for the cultivation of forage plants (Regional Statistics Malta 2021 Edition, 2021). The Maltese flora has been found to originate mostly from the Mediterranean region, with a percentage of about 66%, whereas the remaining species come from the rest of Europe and sub-tropical regions. It has been found that there are approximately 458 medicinal taxa, with certain plant families having more importance than others (Attard et al., 2015).

Despite the country's small size, there seems to be multiple medicinal plants with great benefits that can be utilised. It may be assumed that, like other countries, there are several Maltese traditional herbal remedies but unfortunately very few are documented. A study done in the Maltese island of Gozo revealed that it is mainly the older generations are aware of many Maltese medicinal plants. It compiles the list of known plants with medicinal properties. One may assume that these plants were also used in Malta. The most common plants, according to the informants of this study, are *Matricaria chamomilla*, *Erica multiflora and Micromeria microphyta* (Caruana and Attard, 2016).

The following plants are found on the Maltese Islands, they have been described and documented in other countries around the world, so have the potential to serve as a local source of natural herbal remedies.

5.1. Native medicinal plants

5.1.1. Capparis orientalis/Capparis spinosa subsp. repestris

Capparis orientalis is an indigenous plant and is legally protected in the Maltese Islands. It is called the 'Caper Bush' in English, and it is known locally by its Maltese name 'Kappar'. This plant is one of two plants found in the Capparidaceae family, the 'Caper family', and is sometimes also referred to as '*Capparis spinosa subsp. repestris. Capparis spinosa* are very common in the Maltese islands, they are adapted to several conditions and so may be found in garigue and maquis habitats, among rocky areas and on cliffs. They are also salt and heat tolerant so withstand the hot summer conditions. They are found as large shrubs to small trees that do not exceed the height of five metres. It is an evergreen shrub that produces white flowers (Figure 3) appearing from April through till September, which consists of four petals and several long purple stamens. Their fruit (Figure 2) is what the plant is known for in the Maltese Islands. They are dark green in colour, ranging from seven to fourteen millimetres. These are pickled and preserved in brine to give a very particular smell and taste. They are used in many Mediterranean dishes including salads, pizza, snacks, and pasta recipes.

Figures 2 (left): Caper Bush fruit (Wikimedia Commons, the free media repository, 2020)
Figure 3 (right): Caper bush flower (Wikimedia Commons, the free media repository, 2021)

Apart from its cuisine uses, *Capparis spinosa* is cultivated for cosmetic and therapeutic reasons. This plant has an anti-helminthic effect by means of an aqueous extract prepared from its fresh leaves and flower buds. It possesses an antioxidant activity as well. This activity is said to be due to the presence of total phenols, flavonoids, and tannins, found in high quantities in the flower buds and at lower levels in the leaves. A study done in sheep has shown that this preparation has a significant effect on adult worms, causing paralysis and then subsequent death, but it also affects egg hatching of the *Haemonchus contortus* species. Further studies and trials are required to assess the efficiency among other species before moving forward with producing formulations (Akkari et al., 2016). Studies suggest that there is a correlation between the extract preparation of the *Capparis spinosa* and phenolic content. Flavonoids, in particular, are said to be responsible for this. Their antioxidant effect has several health benefits by offering protection against free radicals within the body. However, alongside flavonoids, the berry also contains free phenolics and carotenoids which also contribute to the antioxidant effect (Allaith, 2016).

Capparis spinosa consists of several other important constituents including saccharides and glycosides, alkaloids, terpenoids and volatile oils, fatty acids, vitamin C, vitamin E and steroids (A, O and M., 2021). It has therefore been known in the past to be anti-fungal, anti-Leishmania, anti-bacterial, anti-viral, anti-hyperglycaemic, hepatoprotective, hypolipidemic, anti-allergenic, immuno-modulatory, antihypertensive, and anti-inflammatory (Akkari et al., 2016). Based on several experiments performed with various animal models, it can be said that the fruit is responsible for the anti-inflammatory, anti-allergic, anti-hyperglycaemic, anti-apoptotic, diuretic and hypotensive effects. The flower buds are responsible for the anti-inflammatory, anti-allergic, anti-viral, immuno-modulatory, antioxidant and anti-mutagenic effects. The aerial parts of the plant are responsible for the hepatoprotective, antioxidant and anti-parasitic effects. The roots are responsible for the hepatoprotective and anti-microbial effects. The seeds are responsible for the anti-proliferative and anti-fungal effects. The whole plant may also be used and like plant crude extracts, it would have an anti-microbial effect. Unfortunately, there is a lack of studies showing the exact mechanism for each effect, but traditional uses have shown that this plant is an essential tool as supportive therapeutic solutions (A, O and M., 2021). Another study done states that, aside from the being beneficial to the liver and gall bladder, *Capparis spinosa* prepared as a decoction, may also be used to treat dehydration and skin diseases in cow, camel, goat, sheep, and donkey (Hussain et al., 2020).

5.1.2. Olea europaea subsp. Europeae

Olea europaea subsp. europaea is an indigenous plant and is legally protected in the Maltese Islands. It is called the 'Olive tree' in English and it is known locally by its Maltese names 'Zebbuga', 'Zejtun', or 'Sigra taz-Zebbug'. This plant is one of the six plants found in the Oleaceae family, the 'Olive family'. *Olea europaea subsp. europaea* are frequently found around the Maltese Islands but they are a threatened species and are therefore red listed. They are big trees that may be several metres tall. They are evergreen and very resistant trees, the leaves are lance-shaped, dark green above and silvery underneath and they are paired, found opposite of each other on the stalk. They produce small white flowers in clusters (Figure 5) during the months of March till May. The olive fruit (Figure 4) is considered a drupe since it contains a stone and will remain on the tree for months, going from the colour green to black. These trees are cultivated for oil extraction by allowing time for them to mature or eaten fresh in their immature state.

Figures 4 (left): Olive tree fruit (Wikimedia Commons, the free media repository, 2020)
Figure 5 (right): Olive tree flower (Wikimedia Commons, the free media repository, 2020)

Olive oil is used traditionally in several ways, either on its own or included in a preparation with other ingredients to create different pastes. It may be mixed with salt and lime, it may be added to olive mill waste or even added to Sticky fleabane (*Dittrichia viscosa*) leaves. These are three separate preparations which may be used against ecto-parasites in goats, specifically sarcoptic and psoroptic mange. Olive oil alone may also be used against lice and fleas in goats. Olive oil prepared as a warm paste may be used as an anti-microbial. It is used for goats by massaging it onto the udder to help the blisters caused by ecthyma, sheep pox and potentially foot and mouth disease. It is also mixed with salt and

used for eye inflammation in sheep. Another preparation used in goats is the impregnation of a burning cotton cloth with olive oil to be used for intra-vaginal cauterisation which is said to contribute to female sterility and help improve fertility (Landau et al., 2014).

This tree may be used in all domestic animals for abdominal pain, constipation, bloat, throat infections, indigestion, scabies, and wounds (Piluzza and Bullitta, 2011). Olive oil has been found to be effective for digestive problems in ruminants, especially in bloated animals. Ingestion of olive oil coupled with walking the animal around to get the gas moving causing eructation or peristalsis (Wynn, S. G., & Fougère, B., 2006). Apart from this, it is very commonly used for the treatment of wounds. It may be added to crushed fresh 'black nightshade' plants with garlic and salt to create an ointment used in both sheep and goats (Landau et al., 2014). Another practice recorded in Spain, is the use of an insect called *Berberomeloe majalis* combined with olive oil to create a wound healing paste. This insect consists of a substance called cantharidin which has been used extensively in the past as treatment of wounds (Benítez et al., 2012). Olive oil has also been said to help relieve inflammation, irritation and pain when applied topically (Wynn, S. G., & Fougère, B., 2006).

This oil extract may also be used as a disinfectant in sheep and goats, commonly after the cauterisation of wounds and has been known to be effective for broken horns, when warmed and mixed with salt. Another traditional procedure of olive oil in sheep and goats is by offering it to the animal to drink it alone, or even mixed with urine sometimes, after the animal has suffered a snake bite (Landau et al., 2014). It is said to be a detoxifying agent and is therefore commonly used for various poisonings (Benítez et al., 2012). Aside from treatment, olive-mill solid waste may be used as bedding for goats. These practices have been recorded in several countries around the Mediterranean area, including Israel and Algeria (Landau et al., 2014). A study done shows that in Portugal, the leaf, fruit, and olive oil may be used in Equine for trauma cases, such as for wounds, for gastrointestinal conditions and respiratory tract problems too (Farinha et al., 2012). There are also recordings in Arabic medicine about the use of olive oil to treat leeches in the mouth, nose, and throat of horses (Wynn, S. G., & Fougère, B., 2006).

The olive tree contains bioactive compounds which are said to give it the potential of being an anti-parasitic plant (Abo-EL-Sooud, 2018). This property is due to a secondary metabolite called maslinic acid and a study shows that it may be an effective natural alternative to treat coccidiosis in chicken (De Pablos, et al, 2010). Another secondary bioactive metabolite that the olive tree possesses, found in the leaves of the plant, is oleuropein. This not only contributes to the characteristic taste of olives but also comes with

certain health benefits. It has antioxidant, anti-inflammatory, anti-atherogenic, anti-cancer, anti-microbial and anti-viral effects. It is also said to be a skin protecting agent and perhaps an anti-aging agent. It is also possible that it may be a neuroprotective chemical, however further studies are required to confirm this (Omar, 2010). Olive leaves are said to influence cardiac function too (Wynn, S. G., & Fougère, B., 2006).

5.1.3. Crataegus monogyna/Crataegus oxyacantha

Crataegus monogyna is an indigenous plant and is legally protected in the Maltese Islands. It is called the 'Common Hawthorn, 'Whithorn' or the 'Single-seed Hawthorn' in English and it is known locally by its Maltese name 'Zaghrun'. This plant is one of many plants found in the Rosaceae family, the 'Rose family'. *Crataegus monogyna* is also referred to as *Crataegus oxyacantha* and are a relatively frequent occurrence in the Maltese Islands. They are deciduous shrubs or small trees, sometimes several metres high. They show horizontal branching with thorns and simple serrated leaves. They produce white or pink clusters of flowers (Figure 7) in the months of March and April, which then produce small pome fruit ranging from red/orange to blue/black in colour (Figure 6). They are popular as ornamental plants because of their pretty coloured flowers and fruit but are also ideal and commonly used for hedges.

Figures 6 (left): Common Hawthorn fruit (Wikimedia Commons, the free media repository, 2020)
Figure 7 (right): Common Hawthorn flower (Wikimedia Commons, the free media repository, 2020)

In the Mediterranean, the thorn of *Crataegus monogyna* may be used in small ruminants to make an incision in wounds, particularly for swelling in the head and ear. This is done to facilitate the healing of the wound (Bullitta et al., 2015). In Israel, this plant's thorn was used in the treatment of mastitis. The ear on the opposite side of the affected udder

is ligated and then the thorn is used to puncture the swollen ear and allow it to drain. Apart from this, the thorn is used for the treatment of snake bites, to puncture the area around the bite (Landau et al., 2014).

This plant is an anti-arrhythmic and a cardio-protective agent. It is said to have a positive inotropic action, so it may be called a cardioactive herb, possibly due to inhibition of sodium/potassium adenosine triphosphate and it also reduces peripheral vascular resistance. It may possibly be used for dilated cardiomyopathy (DCM). It a hypotensive agent and may be used in feline hyperthyroidism too. The leaves and flowers of *Crataegus mongyna* contain oligomeric proanthocyanidins (OPCs) which are said to provide an antioxidant effect. It is also an anti-cancer agent by preventing local invasion. This is done by either affecting cell migration or by inhibiting elastase and hyaluronidase, together with its enzymes, and thus affecting the permeability of the cell (Wynn, S. G., & Fougère, B., 2006).

Crataegus monogyna is traditionally used in China for the treatment of the Equine species with loss in condition but also with arthritis due to its anti-inflammatory properties, normally given as a mixture with other therapeutic plants. A similar preparation is used for laminitis, where is it said to ease the pain and improve blood flow to the hoof, in turn, promoting growth and development of hoof tissue. This is essential for chronic laminitic horses. Apart from this, *Crataegus monogyna* is used to help with anxiety in horses, it is combined with several other herbs that collectively help calm horses down.

5.1.4. Verbena officinalis

Verbena officinalis is an indigenous plant in the Maltese Islands. It is called the 'Common Verbena', 'Vervain' or 'Herb-of-the-cross' in English and It is known by its Maltese name 'Buqexrem'. This plant is one of the five plants in the Verbenaceae family, the 'Vervain family'. *Verbena officinalis* is commonly found in the Maltese Islands. This plant is perennial with simple opposite hairy leaves (Figure 8), and they produce blue or violet small flowers which are lobed and serrated with hairs too (Figure 9), in the months of April until December. This plant is known for its medicinal properties.

Figures 8 (left): Vervain plant (Wikimedia Commons, the free media repository, 2020)
Figure 9 (right): Vervain flower (Wikimedia Commons, the free media repository, 2020)

Verbena officinalis is considered a terpenoid-rich herb, with iridoid glycosides being the main one. It is also considered a nervine tonic herb meaning it has a calming effect on a nervous system and has been historically used as a supportive treatment for epilepsy and seizures in general. It is an anti-spasmodic and it is said to have an oestrogen-like activity. It has been found that this plant may also be considered an antilithic because as an infusion it prevents and treats the formation of kidney stones, either due to its alkalising ability or due to its saponin content. This plant is also said to have vermifuge action and so may be used an anti-helminthic (Wynn, S. G., & Fougère, B., 2006).

The leaves of *Verbena officinalis* are prepared by decoction and used as an external treatment of wounds (Benítez et al., 2012). The aerial parts of this plant may be used as a galactagogue and this is said to be due to its constituents, particularly iridoid glycosides, tannins, volatile oils, saponins, mucilage and alkaloids (Behera et al., 2014). In Serbia, the water extract may be used to treat diarrhoea in ruminants (Marković et al., 2021).

5.1.5. Urtica dioica

Urtica dioica is an indigenous plant in the Maltese Islands. It is called the ‘Common Nettle’ or ‘Stinging Nettle’ in English and it is known locally by its Maltese name ‘Hurrieq’. This plant is one of the seven plants found in the Urticaceae family, the ‘Nettle family’. *Urtica dioica* are of frequent occurrence in the Maltese islands. They are annual herbaceous plants and so are referred to as therophytes (Figure 10). Its leaves are known for their pretty

heart shaped appearance (Figure 11) with little hairs on them that give a stinging sensation upon touching them. Its flowers are produced through the months of March till June but are often hard to spot as they are normally green or yellow in colour, forming clusters from the stem like catkins.

Urtica dioica is known as a source of herbal medicine but is also used in the production of textiles and cosmetics. The medicinal properties of this plant are known and commonly used in Switzerland, Spain, Italy and Austria, according to recorded documents.

Figures 10 (left): Stinging Nettle plant (Wikimedia Commons, the free media repository, 2020)
Figure 11 (right): Stinging Nettle leaves (Wikimedia Commons, the free media repository, 2020)

The aerial parts of *Urtica dioica* are said to have galactopoietic properties and so increases the production and flow of milk. This plant contains Vitamin A, B complexes, C, D, minerals such as iron, phosphorus, potassium, sulphur, and magnesium, as well as fibre (Behera et al., 2014). In Canada, *Urtica dioica* may be used for diarrhoea (Lans et al., 2007). In Estonia, this plant is used in feed for cattle, to treat haematuria by means of a decoction of the root, the aerial parts may be used as a tonic and a decoction of this plant was used to treat pneumonia in cattle (McGaw and Abdalla, 2020). In Uttaranchal, this plant is used for haematuria, arthritis, soreness, to regulate fertility, bone fractures, wounds, sprains, lactation, abdominal pain, and internal injury.

In certain parts of Switzerland, this plant is used to treat more than one species, it is used for cattle, goats, pigs, and donkeys. It is administered orally, either directly or via an infusion. It is used in reproductive problems, gastrointestinal conditions, metabolic dysfunction, and urinary system bacterial and inflammatory diseases. It may also be used to help joint disease, applied orally or externally, and for different skin conditions when applied externally. It is said to be an anti-hypertensive, analgesic, and a local anaesthetic (Disler et al., 2014).

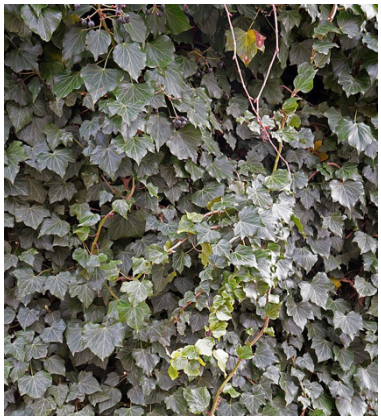
In the Mediterranean region, this plant is used to treat contusions in cattle, sheep, and horses, perhaps due to its antioxidant capacity (Piluzza and Bullitta, 2011). In Spain, this plant is made into a well-known preparation together with flour, to help females increase their milk production. (Amich et al., 2011). In Navarra, the leaf buds of this plant are used to help treat various pig diseases whereas the aerial parts, in the form of an infusion, is used for digestive system problems, particularly bloating of ewes in spring (Akerreta et al., 2010). In the Himalayas, the roots of this plant are prepared into a paste to be applied externally on the area of bone fractures whereas the leaves are mixed and crushed together with a ripe tamarind fruit and administered to cattle to increase their milk yield. In other parts of India, the latter preparation is also said to increase egg production in poultry (Bharati and Sharma, 2012).

This leaf of this plant is a diuretic, possibly due to its high potassium content, is a haemostatic and has anti-inflammatory properties too. This latter property of this plant is exhibited by the leaf and is said to be because cytokine release is decreased and there is also a decreased PGE2 synthesis. The juice of this plant may be prescribed as an antidote to rash and studies show that frozen nettles may be used to control symptoms of allergic rhinitis, treat skin conditions and insect bites too. These characteristics may be due to the presence of a component called quercetin. It has been shown that the alcoholic extract of the root of this plant helps bladder obstruction symptoms as well as decrease the post-voidal amount of urine left in the bladder and so is potentially effective in human males that suffer from Benign Prostatic Hyperplasia (BPH). The translation of this remedy into the veterinary field has yet to be fully investigated. Apart from this, this plant may be used in chronic renal patients as it has been known to decrease blood creatinine levels.

Urtica dioica may be used for the treatment of minor wounds or hot spots due to its styptic ability, when using powdered leaves or prepared as an infusion. This plant may also be referred to as an anodyne since it may reduce pain quite effectively. It is also one of the plants used for ringworm and potentially for ulcers too. The leaf of this plant is commonly used in equine medicine, mainly as a tonic since it is high in nutrients but is also known to help in anaemic horses. It may be used as a diuretic, an anti-spasmodic and an expectorant. Different parts of this plant are used separately, the leaf is typical said to aid inflammatory diseases, the root prostatic diseases, and the seed renal diseases as it is said to be a kidney trophorestorative (Wynn, S. G., & Fougère, B., 2006).

5.1.6. Hedera helix/Hedera taurica

Hedera helix is an indigenous plant in the Maltese Islands. It is called 'Ivy' or the 'English Ivy' in English and it is known locally by its Maltese name 'Liedna'. This plant is one of two plants in the Araliaceae family, the 'Aralia family'. *Hedera helix* is also referred to as *Hedera taurica* and is frequently found in the Maltese Islands. This plant is an evergreen aggressive climber (Figure 12) which thrives in shaded and damp areas so it is commonly found wrapped around trees and walls and may even be found crawling the ground in certain habitats. It has simple leaves, normally having three or five lobes (Figure 13) and produces an almost globular cluster of yellow/green flowers during the months of September through till November, which are sometimes hard to spot.



Figures 12 (left): Ivy plant (Wikimedia Commons, the free media repository, 2021)
Figure 13 (right): Ivy leaves (Wikimedia Commons, the free media repository, 2021)

In India, the leaves of *Hedera helix* are prepared into a paste and applied to snake bite wounds. This plant is also administered with feed in cases of placental retention. Apart from this, in Italy, an infusion of its leaves is prepared and administered to cattle that have suffered from postpartum diseases as well as being added to feed to facilitate calving in other areas of the country. The use of this plant in the treatment of these reproductive conditions is said to be because of its components, particularly saponins, chlorogenic and caffeic acid, hederacoside, flavonoids and glycosides (El Mahdy et al., 2019).

Using this plant in cows for the treatment of postpartum disorders is known not only in Italy but also in other countries around the Mediterranean region. Studies also show that this plant is an antioxidant, believed to be because of its total phenolic content (Piluzza and

Bullitta, 2011). In the region of Spain, it is said that this plant has an anaphrodisiac effect in rabbits meaning their sexual desire is reduced. The leaves of this plant, sometimes together with other plants, are given to ruminants to treat reproductive problems, especially to expel the placenta postpartum (McGaw and Abdalla, 2020).

Due to the saponin content of this plant, it tends to increase the production of mucus in the lungs as well as causing coughing, since these chemicals have an expectorant activity. Studies also suggest that this plant may be beneficial to improve respiratory conditions. It is also one of the herbs which may be used to treat cutaneous ulcers, slow-healing abscesses, and wounds. It is also one of the plants used in the treatment of ringworm and possibly ulcers (Wynn, S. G., & Fougère, B., 2006).

5.1.7. Mentha pulegium

Mentha pulegium is an indigenous plant in the Maltese Islands. It is called the 'European/ English Pennyroyal', the 'Pennyroyal Mint' or the 'Peppermint' in English and it is known locally by its Maltese name 'Plejju'. This plant is one of several plants found in the Lamiaceae family, the 'Mint Family'. The name *Mentha pulegium* has an interesting origin, the word '*Mentha*' was the name of a nymph in Greek mythology that was transformed into a mint plant whereas the term '*pulegium*' originates from the Latin word 'pulex' which means flea-repellent. This plant is a common finding in the Maltese Islands, especially in damp shady areas such as near valleys or around watercourses. It is a perennial small plant with oval obtuse bright green leaves (Figure 14). They produce violet flowers in axillary whorls (Figure 15) through the months of April to July. It is known for emitting a certain characteristic minty aroma.

Figures 14 (left): Pennyroyal plant (Wikimedia Commons, the free media repository, 2020)
Figure 15 (right): Pennyroyal flower (Wikimedia Commons, the free media repository, 2020)

In Spain, the flowering stems of *Mentha pulegium* are used for external use, either prepared as a decoction or applied directly, and are commonly used as a preventative of postpartum diseases as well as fleas (Benítez et al., 2012). In Portugal, the aerial plant of this plant is used in Equine to treat respiratory tract infections and gastrointestinal conditions, such as constipation. Using this plant for prevention of parasite infestation may be a possibility (Farinha et al., 2012).

This plant consists of a monoterpenoid known as piperitone which has been shown to have anti-bacterial properties (Abdolpour et al., 2007). Not too much research has been performed but it is said to potentially have analgesic and sedative effects too.

5.2. Naturalised alien medicinal plants

5.2.1. Nicotiana glauca

Nicotiana glauca is a naturalised alien species in the Maltese Islands. It is called the 'Glaucous Tobacco', 'Tree Tobacco' or 'Shrub Tobacco' in English and it is known locally by its Maltese name 'Tabakk tas-swar'. This plant is one of several plants found in the Solanaceae family, the 'Potato family'. *Nicotiana glauca* are frequently found around the Maltese Islands, commonly used as ornamental plants around walls and the roads. Being an alien species, they were introduced years ago and have successfully spread to form a well-established yet non-invasive population. They are normally big shrubs or high trees usually several metres in height (Figure 16), with thick rubbery leaves. It produces yellow tubular shaped flowers (Figure 17) between the months of April and October. *Nicotiana glauca* was originally intended as an ornamental plant but is now known for its therapeutic characteristics.

Figures 16 (left): Tree tobacco plant (Wikimedia Commons, the free media repository, 2021)
Figure 17 (right): Tree tobacco flower (Wikimedia Commons, the free media repository, 2021)

In Cameroon, *Nicotiana glauca* is used in livestock treatment for Blackleg, snake bites, ticks and for fattening of cattle. The leaves of the plant are used and may be given orally, nasally, or topically. They are dried, soaked overnight in water and then either squeezed to be offered to the animal or made into a decoction to apply the extract onto the animal externally (Dzoyem et al., 2020).

Nicotiana glauca is known to be very useful in Israel for various conditions. They may be used to treat ecto-parasites, like they are in Spain (Farinha et al., 2012) and Portugal (Farinha et al., 2012). The leaves are used to treat mange in all livestock by macerating them, heating them, and then scrubbing them on the affected areas and they may also be used for the treatment of lice and fleas. For the latter, the leaves must be dried and infused to create a solution which is then applied to the area, a treatment also used in Italy, as is the one before it. This plant may also be burned, and the smoke exhaled into the nostril of sheep and goats as a treatment of ticks and particularly the larvae of *Oestrus ovis*. This plant is said to influence internal diseases, particularly gastro-intestinal conditions such as colic, diarrhoea and endo-parasites, in all livestock especially horses. The leaves are dried, crushed in lukewarm water and left for a few days, it is then bottle-fed to the animals (Landau et al., 2014). Its anti-parasitic effect against certain larvae has been proven in a Maltese study that claims this effect is due to an alkaloid called anabasine, which is toxic to certain parasites (Attard et al., 2021).

This plant is rich in alkaloids, and aside from anabasine, pyridine is also a major component. Studies have shown that the *Nicotiana glauca* plant has significant effects against Avian Influenza, the aqueous extract increases the survival of infected chick embryos. It may also be used to help diarrhoea cases in cattle as well as for mange in canine.

This plant was among the most popular herbs used as veterinary medicines of the horses at war during the American Civil war and they were known as 'horse medicine'. They were also used historically for what was believed to be chronic toxicities (Wynn, S. G., & Fougère, B., 2006).

Nicotiana glauca, particularly the leaves, is used in Spain in the treatment of wound healing through topical application (Farinha et al., 2012). In Botswana, this plant aids in several diseases used as a common general remedy in poultry. Here, it is known for being an anti-diarrhoeal, narcotic and an emollient. Its leaf extract and juice are also used in wound healing (Dikeme et al., 2010). Further studies are required to verify these uses.

5.2.2. Calendula officinalis

Calendula officinalis is a naturalised alien species in the Maltese Islands. It is called 'Pot Marigold' or 'English Marigold' in English and it is known locally by its Maltese name 'Suffejra tal-gonna'. This plant forms part of the large Asteraceae family, the 'Daisy' or 'Sunflower family'. *Calendula officinalis* is not a common finding around the Maltese Islands. This plant is herbaceous, annual to perennial, only woody at their base with erect stems (Figure 18). Their leaves are simple, spirally arranged, and hairy and they produce bright yellow or orange flowers, each with several layers of petals (Figure 19), all throughout the period from January to June. In fact, the term *Calendula* comes from the Latin word 'kalendae' meaning first day of the month, but it is said to be called this because of the long flowering season. This plant is known for its brightly coloured flowers and are cultivated and used mostly as ornamental plants, usually at the side of roads or due to escapees, at the side of fields, in disturbed ground and sometimes even in the garigue habitat.

Figures 18 (left): Pot Marigold plant (Wikimedia Commons, the free media repository, 2020)
Figure 19 (right): Pot Marigold flower (Wikimedia Commons, the free media repository, 2020)

In Serbia, *Calendula officinalis* is known to be an anti-inflammatory and an anti-septic so may be used for the treatment of wounds as it encourages granular tissue formation and epithelization, therefore promoting wound healing. In South Africa, the water extract of this plant may be used for the treatment of respiratory system conditions, such as colds, and the oil may be used externally to treat erysipelas in swine and sheep (Marković et al., 2021).

It is mainly the flower of this plant that possesses medicinal properties. This plant may be used as a general tonic in equine, fed periodically throughout the year. Its proven anti-ulcer effect (Attard et al., 2015) means it may also be used to help the treatment of gastric ulcers in horses. This is prepared in a specific way with other herbs. This plant is said to be an anti-septic, reduces blood lipids, anti-inflammatory, astringent, spasmolytic, and a cholagogue (Wynn, S. G., & Fougère, B., 2006).

The *Calendula officinalis* is very popular in Saaremaa and is used in a variety of conditions. In Belarus, this plant is used to prevent miscarriage in cows and in Albacete, a decoction of this plant is prepared and used in Equine for improving their coat (McGaw and Abdalla, 2020).

This plant consists of several metabolites including terpenoids, carotenoids, flavonoids, coumarins, polysaccharides, tannins, and saponosides. One important constituent is a triterpenoid known as oleanolic acid which is shown to be responsible for the anti-microbial property of this plant as well as the anti-inflammatory effect. Investigations show that this plant effects the cardiovascular and nervous systems too (Attard et al., 2015).

5.2.3. Melissa officinalis

Melissa officinalis is a naturalised alien species in the Maltese Islands. It is called the 'Lemon Balm' or 'Balm' in English and it is known locally by its Maltese names 'Naghniegh in-nahal', 'Burieha' or 'Melissa'. This plant is one of many plants found in the Lamiaceae family, the 'Mint Family'. *Melissa officinalis* are a rare finding in the Maltese Islands but seems to thrive in shady places. It is a perennial small woody shrub with a four-edged stalk consisting of hairs too. It has oval or heart-shaped leaves with serrated edges (Figure 20) and produces inconspicuous white yellowish flowers (Figure 21) in the months of May to June. This plant is known for being rich in nectar and is cultivated to be used and sold for medicinal purposes.

Figures 20 (left): Lemon Balm plant (Wikimedia Commons, the free media repository, 2021)
Figure 21 (right): Lemon Balm flower (Wikimedia Commons, the free media repository, 2021)

In Canada, *Melissa officinalis* is used based on its anti-inflammatory properties which is believed to be due to certain constituents, namely terpenoids, flavonoids and rosmarinic acid. In Brazil, the leaves of this plant are used treat pneumonia, pleuropneumonia, fever, and eye infections (McGaw and Abdalla, 2020).

This plant is a terpenoid rich herb due to its high content of monoterpenoids and sesquiterpenoids. It also contains phenylpropanoids. This plant is considered an anti-spasmodic as when prepared as an ethanol extract, it was found to inhibit certain contractions in the smooth muscle, particularly the ones caused by barium and histamine. It has been shown that it also has thyroid-inhibiting activity. The extracts of this plant have a protective effect on the stomach and may be called an antacid as well as an anti-ulcer herb. It may be prepared with several other plants in specific proportions to be used to treat chronic gastritis. It also may be used to treat nausea symptoms. Together with a combination of other herbs, it may help with chronic colitis by easing the pain. Studies also show that this plant has a sedative effect and is an option to control agitation, anxiety, irritability, and tenseness. It appears that this plant may also be used as an anti-viral against herpes virus (Wynn, S. G., & Fougère, B., 2006).

5.3. Cultivated medicinal plants

5.3.1. Allium sativum

Allium sativum is a cultivated plant grown in the Maltese Islands. It is referred to as 'Garlic' or 'Cultivated Garlic' in English and it is known locally by its Maltese name 'Tewm'. This plant is one of many plants found in the Amaryllidaceae family, the 'Daffodil/Amaryllis family'. *Allium sativum* are grown for agricultural purposes and so are not frequently found in the wild around the Maltese Islands. The plant is rather small, usually about sixty centimetres tall (Figure 22). It has long narrow leaves arising from underground bulbs. These bulbs consist of bulbets which are called cloves and have a characteristic smell and taste, the part of the plant that it is known for. During the months of May and June, this plant produces a spherical cluster of flowers, which are either whitish-green or purple in colour (Figure 23). The garlic cloves have had many uses over the years, the most popular being as an additive to cuisine, however, they also serve an important role in medicinal formulations.

Figures 22 (left): Garlic plant (Wikimedia Commons, the free media repository, 2020)
Figure 23 (right): Garlic flower (Wikimedia Commons, the free media repository, 2020)

The bulbs of *Allium sativum* are used mixed with olive oil as an anti-parasitic for cats in Algeria or to help the digestion of cattle in Morocco. The Sahrawis tribe often heat treat the bulbs to use them on camels to treat reproductive conditions, mainly post-partum prolapse and mastitis. Its use has also been recorded in Spain, where it is used for livestock to treat problems related to the digestive system (Landau et al., 2014). In several countries,

including India, Pakistan and Sri Lanka, the bulb of *Allium sativum* may be used to treat cough orally and mastitis topically. In British Colombia, Trinidad and Tobago, garlic is used for cough too, often in a mixture with coconut and turmeric. In the past, this plant was used in Belarus to treat rumination problems among cattle.

Apart from the bulb, the stem and flowers may also be used. Targeted conditions include diarrhoea, colic, indigestion, mouth sores, stomach inflammation and abdominal pain. Aside from this, in Tenerife, garlic may be crushed together with pepper to be used on a poultice to treat caseous lymphadenitis in goats (Dzoyem et al., 2020).

This plant may also be added to yoghurt and salt to create a paste used as a treatment for goat kids to treat blistering causing diseases such as ecthyma, sheep pox and foot and mouth disease. Another paste may be prepared with olive oil and salt to treat wounds on the udder in sheep and goats. An alternative for the treatment of udder wounds in sheep and goats is by mixing garlic with cinnamon and eggplant (Landau et al., 2014).

Garlic extract may be called an anti-coccidia, amoebicidal, anti-bacterial, antioxidant, and an insecticide (Abo-EL-Sooud, 2018). The main compound in *Allium sativum* is an allyl disulphide known as allicin and is said to be responsible for the major properties of this plant. *Allium sativa* is virucidal against different types of viruses. It may be used against Avian Influenza, Herpes simplex virus types 1 and 2, human rhinovirus type 2, parainfluenza 3, Vaccinia virus and vesicular stomatitis virus. It is meant to cause perspiration as well as act as an anti-microbial. It is said to help the digestive system and may be used for pain and bloating but also to maintain normal healthy gut peristaltic movement (Wynn, S. G., & Fougère, B., 2006). In Israel, the bulb of Allium sativum is crushed with water and used for the treatment of gastrointestinal diseases in Equine, particularly for colic and diarrhoea as well as parasites (Landau et al., 2014).

Allium sativum is very prevalent in Greek and Egyptian history because of its potential to provide physical strength to workers, among several other health benefits. In Cameroon, *Allium sativum* is used as an anti-parasitic agent. Its bulbs are crushed and mixed with water to be used as a topical treatment for lice and to treat coccidiosis (Dzoyem et al., 2020). Allicin contributes to this anti-parasitic effect. This may be used to treat *Haemonchus contortus* in goats and sheep and coccidiosis in goats and rabbits (Abo-EL-Sooud, 2018). Its use as an anti-helminthic has been described for calves, poultry and sheep in Italy as well as for camels and cows in Saudi-Arabia (Landau et al., 2014).

In Portugal, the bulb of *Allium sativum* is used to treat respiratory tract infections in Equine (Farinha et al., 2012). It has been shown that this plant is proven to help reduce the

respiratory rate by reducing the neutrophils and increasing the number of macrophages. It is also used as a vegetal preservative to stabilise several plant extracts formulations (Dzoyem et al., 2020). It possibly influences the nervous, reproductive, and circulatory systems. It may also be used to help support the immune system during chronic disease. Nowadays, several feed preparations include garlic as a taste enhancer too (Wynn, S. G., & Fougère, B., 2006).

5.3.2. Salvia officinalis

Salvia officinalis is a cultivated species in the Maltese islands, meaning that it was introduced into the country for agricultural purposes, it is therefore legally protected to avoid exploitation. It is called the 'Common Sage' in English, and it is known locally by its Maltese name 'Salvja tal-ikel'. This plant is one of many plants found in the Lamiaceae family, the 'Mint family'. *Salvia officinalis* is often grown in a garden or found close to cultivated grounds. In Latin, the word *'Salvia*' means saving or healing and *'officinalis'* refers to its commercial purpose, both terms believed to be given due to medicinal properties. This plant is a perennial, small, woody shrub with oval, rough, wrinkly leaves that may be greenish white in colour (Figure 24). They produce upright spikes with violet, pink or blue flowers (Figure 25) during the months of May until August, which are highly attractive to insects. This plant is known for its characteristic aroma which makes it a popular choice in the flavouring of several dishes and although native in the Mediterranean area, it is cultivated in several regions around the world. It is also commonly used as an ornamental plant and its leaves are used in medicine and perfumery.

Figures 24 (left): Common Sage plant (Wikimedia Commons, the free media repository, 2020)
Figure 25 (right): Common Sage flower (Wikimedia Commons, the free media repository, 2021)

In British Columbia, Canada, *Salvia officinalis* may be used to treat endoparasites in pigs and pets. The aerial parts may be used to treat roundworms. This plant has also shown anti-bacterial potential where it has had a significant inhibitory activity against *Klebsiella, Enterobacter* including *Escherichia coli, Proteus mirabilis, Morganella morganii* and *Helicobacter pylori*. In Luxembourg, this plant has also been used in the past by blacksmiths, together with other plants, as an anti-inflammatory. *Salvia officinalis* is said to have anti-nociceptive, insecticidal, and anthelminthic activity, believed to be possible due to component called alpha-thujone. It is proven to have good immunity modulatory activities. It also has an anti-leishmanial activity because of the phenols present in its aerial parts, particularly the hydrolysable tannins and caffeic acid-derived metabolites they contain (Brauer et al., 2007).

Salvia officinalis is a terpenoid-rich herb, containing specifically monoterpenoids and sesquiterpenoids. The leaves are the most important part of the plant in terms of its medicinal properties. This *Salvia* species is said to influence heart function and have an anti-bacterial effect. It is an anti-spasmodic and it has a carminative effect. Studies show that the *Salvia officinalis* significantly decreases throat pain and may be classed as an anti-inflammatory. It also possesses cholinergic binding capacity which decreases the destruction of the neurotransmitter acetylcholine which helps maintain the level of neurons for longer. This was noted by an improved level of cognition in a human study done with Alzheimer patients. Apart from this, it was found that memory and alertness may be improved with the use of a plant of the same Genus but a different species. This just goes to show the great potential these plants have in the treatment of neurological diseases, a concept that requires further research, especially in animals, but may currently be used to aid the treatment of cognitive dysfunction. *Salvia officinalis* also shows hepato-protective properties, gastrointestinal diseases such as stomatitis, gingivitis, flatulence, and diarrhoea. It is also possible to use this plant as a supportive treatment to azathioprine treatment, possibly because of its hepato-protective, antioxidant and gastrointestinal-protective characteristics (Wynn, S. G., & Fougère, B., 2006).

This plant is considered an anti-galactagogue herb meaning that it decreases the secretion of milk, and it is therefore used for the treatment of post-partum mastitis (Behera et al., 2014). In Serbia, the leaf of this plant is mixed with water and the extract is used as a treatment of the respiratory system, particularly for cough and colds (Marković et al., 2021), a practice commonly done in Canada too. In Canada, *Salvia officinalis* is also used in goats for drying them off. This is done using dried sage prepared into a paste and applied to the

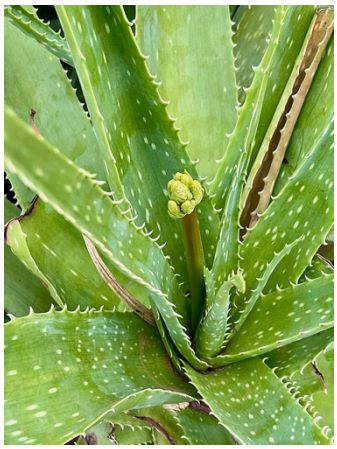
udder of the goat or may also be given orally, normally mixed with molasses to make it more enticing. This is said to initiate milk reduction and help introduce them into the dry period (Lans et al., 2007). A study also showed the anti-parasitic potential that this plant has, especially on gastrointestinal parasites, a treatment known to be used in Iran (Amirmohammadi et al., 2014).

Salvia officinalis contains biologically active polyphenol compounds, mainly phenolic acids and flavonoids which contribute to the medicinal properties of this plant. Studies shows that the extract of the leaves of this plant exhibit an antioxidant activity and may be used to treat diseases associated with the production of free radicals. It was also shown that the essential oil of this plant has an anti-bacterial activity, possibly even against food-borne bacteria and so may have a significant benefit in food preparations (Abdelkader et al., 2014).

5.4. Medicinal plants introduced years ago

5.4.1. Aloe vera/Aloe barbadensis

Aloe vera is referred to as an archeophyte since it is technically not a native species, but it has been present in the Maltese Islands for over a thousand years. It is called the 'Yellow Aloe', the 'Mediterranean Aloe' or the 'True Aloe' in English and it is known locally by its Maltese name 'Sabbara'. This plant is one of six plants found in the Xanthorrhoeceae family, the 'Grass Tree family' and may also be referred to as *Aloe barbadensis*. *Aloe vera* are rarely found on the Maltese Islands and are red listed as their species is threatened. They are small shrubs which do not normally exceed a hundred centimetres in height. They have a stolon which gives off several fleshy thick leaves that have sharp serrated edged extensions coming out of them (Figure 26). Their ability to produce flowers depends on the age of the plant and the climate but in appropriate conditions, it produces a cluster of flowers on a stem called an inflorescence (Figure 27). These are normally yellow and blossom during the months of April till September. This plant is well known for its therapeutic use in multiple various conditions.



Figures 26 (left): True Aloe plant (Wikimedia Commons, the free media repository, 2021)
Figure 27 (right): True Aloe *vera* flower (Wikimedia Commons, the free media repository, 2021)

In Botswana, *Aloe Vera* is amongst the most wildly used herbal remedies, used for gastrointestinal conditions and as an anti-coccidiosis agent, in human and animal medicine, especially poultry. The coccidiostat property is being practiced on poultry in Zimbabwe, as well as the treatment of fowl typhoid and Newcastle disease (Dikeme et al., 2010). Aloe vera leaves may be used as an anti-parasitic due to a compound called acemann and it is also known to be an immune-modulator and a growth promoter in chickens (Abo-EL-Sooud, 2018).

In Cameroon, the leaves of *Aloe vera* are used topically for the treatment of wounds (Dzoyem et al., 2020), a practice described as a treatment for horses in Portugal too (Farinha et al, 2012). This plant has also been known to help with grass rash, sunburn, and cracked heels in horses (Lans et al., 2006). In Trinidad and Tobago, apart from external and internal wound care, *Aloe vera* is also used in ruminants to make poultices, to aid reproductive problems such as inducing oestrus and cleaning out the womb and for cases of tendonitis (Brown, et al, 1998). The treatment of placental retention in horses has also been documented (Lans et al., 2006).

In certain parts of India, *Aloe Vera* leaves are made into a paste for cattle with unconscious condition but also is popular in some tribes as a general prophylactic or supportive treatment for various diseases among livestock (Ayyanar et al., 2011).

This plant contains anthraquinones, saponins, and polysaccharides, amongst others. It may be said that *Aloe vera* also has an anti-viral effect against enveloped viruses, an anti-bacterial, diuretic, vasorelaxant, anti-inflammatory, anti-proliferative and anti-carcinogenic

effect too. These properties may be due to the presence of an anthraquinone called emodin. The term 'Aloe' comes from the Arabic word 'Alloch', meaning bitter. In fact, the extract of this plant is a yellow bitter juice obtained from its fresh leaves. This extract also contains emodin and may be used as a cathartic agent. It may also be used as an anti-parasitic and this substance in the form of gel has been shown to be bactericidal against some significant bacteria such as *Bacillus* and *Pseudomonas*, fungi such as *Trichophyton* and yeast such as *Candida* (Lans et al., 2007).

Aside from emodin, studies show that another major anthraquinone is barbaloin and this greatly contributes to the anti-inflammatory, analgesic, wound-healing, anti-pyretic, anti-microbial and anti-carcinogenic effects. Aloenin, another anthraquinone, is said to contribute to an anti-viral property, particularly against Newcastle disease (Brown et al., 2007). Studies show that *Aloe Vera* may be used in EIPH (exercise induced pulmonary haemorrhage) in horses, sometimes combined with honey, the white of an egg and pureed lemon. (Lans et al., 2006). In Trinidad and Tobago, it has also been found that the metabolite emodin is likely to be largely responsible for a strong laxative effect (Brown et al., 2007). Its use for constipation has also been determined as valid by the FDA (The Food and Drug Association) due to its laxative properties. In British Colombia, *Aloe vera* gel is used in pets and pigs to treat gastrointestinal problems related to the stomach, particularly vomiting and irritation as it helps ease the discomfort and restore normal digestive function.

5.5. Others:

There are believed to be thousands of medicinal plants. Some are greatly researched but there are so many more that have been documented to have certain effects which have not yet been proven. In this chapter, some of these plants are discussed.

Foeniculum vulgare is an indigenous plant in the Maltese islands. It is called the 'Fennel' in English and it known locally by its Maltese names 'Buzbiez'. This plant is one of many plants found in the Apiaceae family, the 'Carrot family' and contains flavonoids and coumarins, among other constituents. This is also considered a phenylpropanoid rich herb. It is said to have galactopoietic properties, meaning it may therefore be used to increase milk production and facilitate the flow and ejection of milk from the udder (Behera et al., 2014). Studies also show that this plant has an anti-bacterial effect by causing loss of cellular contents (Abo-EL-Sooud, 2018) and it helps the gastrointestinal system's motility and helps

ease intestinal spasms. It may therefore be used to treat colic. It has been shown to have anti-inflammatory effects and its extract is a diuretic, analgesic, anti-pyretic and cholagogue agent (Wynn, S. G., & Fougère, B., 2006). In Spain, a decoction of this plant may be used to facilitate wound healing (Benítez et al., 2012). In Portugal, the aerial parts of this plant may be used for gastrointestinal problems, respiratory tract conditions and dystocia (Farinha et al., 2012).

Ficus carica is an indigenous plant in the Maltese Islands. It is called the 'Fig tree', the 'Capri Fig' or the 'Common Fig' in English and it is known locally by its Maltese name 'Tina', 'Farkizzan', or 'Bajtar ta San Gwann'. This plant is one of the ten plants found in the Moraceae faimly, the 'Mulberry family'. This plant is also referred to as *Ficus carica var. domestica* and is a common finding in the Maltese Islands. In Spain, the stems of Ficus carica have been known to be used against flatulence (Benítez et al., 2012). In Portugal, this plant is used alone or in a mixture, for respiratory tract and gastrointestinal conditions (Farinha et al., 2012). Water extract of the leaf of this plant may be used in Serbia to treat diarrhoea (Marković et al., 2021) and it has been used to treat pneumonia in domestic animals (Piluzza and Bullitta, 2011). This plant has been used as an anti-bacterial in the treatment of burns and ulcers and shown to possess antioxidant properties (Wynn, S. G., & Fougère, B., 2006).

Allium cepa is a cultivated species in the Maltese Islands. It is called the 'Garden Onion' or the 'Bulb Onion' in English and it is known locally by its Maltese name 'Basla'. This plant is one of many plants found in the Amaryllidaceae family, the 'Daffodil or Amaryllis family'. This plant is also referred to as *Cepa vulagaris* and is short lived in the wild. Studies show that this plant has insecticidal, repellent, anti-parasitic and antiseptic actions as well as being able to treat gastrointestinal problems. It is also an anti-protozoal, anti-fungal and an antibacterial. These effects are said to be caused by the presence of fructans, flavonoids and organo-sulphur compounds as well as proteins, saponins and phenolic compounds. This plant has several other constituents. It has therefore been successful in the treatment of a variety of problems including gastrointestinal, respiratory, urinary conditions as well as fever and endo-/ectoparasites (Kale et al., 2021). It is documented as a use for the treatment of snakebites (Wynn, S. G., & Fougère, B., 2006).

Vitis vinifera is a naturalised alien species in the Maltese Islands. It is called the 'Grape vine' or the 'European vine' in English and it is known locally by its Maltese names ' Dielja' or 'Sigra tal-Gheneb'. This plant in one of four plants found in the Vitaceae family, the 'Vine family'. *Vitis vinifera* is also referred to as *Vitis laciniosa* and is frequently found across the Maltese Islands. In Israel, the fruit is boiled until it forms a syrup consistency and

mixed with lupine grain infusion. It is said to help all livestock suffering from stomach pain when bottle-fed three times a day (Landau et al., 2014). In Portugal, this fruit/grape of this plant may be used in horses for gastrointestinal conditions (Farinha et al., 2012). Studies show that this plant is a proanthocyanidin rich herb which gives it anti-parasitic properties. This has been shown to be effective against coccidiosis due to it decreasing oxidative stress. It has also shown to be an anti-mutagenic due to the presence of oligomeric proanthocyanidins (OPCs). (Wynn, S. G., & Fougère, B., 2006). These chemicals also have a hypolipidemic, antioxidant and anti-bacterial effect in poultry (Abo-EL-Sooud, 2018). It is a diuretic and a haemostatic. Studies show that this plant contains resveratrol which is a phytoalexin and is responsible for some of these medicinal properties, including it being an antioxidant, an anti-inflammatory, and an anti-carcinogenic agent. It induces apoptosis, decreases cell proliferation, and ceases the metabolism of carcinogens. (Wynn, S. G., & Fougère, B., 2006).

Verbascum thapsus is an alien species in the Maltese Islands. It is called the 'Great Mullein' or the 'Common Mullein' in English and it is unfortunately its Maltese name is not known. This plant is one of nine plants found in the Scrophulariceae family, the 'Figwort family'. *Verbascum thapsus* is casually present in the Maltese Islands. This plant contains polysaccharides, flavonoids and saponins. Its flowers infused in oil may be used to help control the production of cerumen as well as aid the inflamed tympanic membrane. The leaves are said to help with inflamed haemorrhoids and ulcers. Due to its anti-catarrhal and expectorant effects, a property caused by saponins, this plant helps with the treatment of bronchitis (Wynn, S. G., & Fougère, B., 2006). It has been documented that a decoction of its leaves may be used for wound healing (Benítez et al., 2012).

Opuntia dillenii is a naturalised alien species in the Maltese Islands. It is called the 'Prickly Pear', 'Indian Fig' and 'Barbary Fig' in English and is known locally by its Maltese name 'Bajtar tax-Xewk', 'Bajtar tal-Indja' or 'Franciz'. This plant is part of the 9 species found in the Cactaceae family, the 'Cactus family'. This plant is extremely common in the Maltese Islands and is known as a polysaccharide rich herb. The flowers are considered flavonoid rich herb but there are limited recordings to its uses (Wynn, S. G., & Fougère, B., 2006).

6. Conclusion

From this study, a few important points may be highlighted. Firstly, Malta possesses numerous medicinal plants which have significant therapeutic properties. According to the mentioned medicinal plants, a few trends may be noticed. It seems that the most common treated conditions include wound treatment, gastrointestinal conditions, parasite prevention and treatment as well as skin conditions. Since the livestock is often the focus of these treatments, most of the proven effects of plant-derived compounds have been confirmed in ruminants, horses and poultry. Anti-inflammatory, antioxidant, anti-bacterial and anti-parasitic properties are the most common characteristics found in the medicinal plants. The families with the most used medicinal plants from the following plants are Asteraceae and Lamiaceae.

It is evident that more research needs to be done to investigate the extent of medicinal plants on our island. There is also still a lot that is unknown about medicinal plants in general, and which of their ethnoveterinary uses are valid and if so, to what extent. When taking into consideration the variety of compounds present in plants, it is no surprise that there is a lot that has yet to be discovered.

7. Summary

In this review, the importance of medicinal plants is discussed. We look into the metabolites of plants and the resulting active constituents which are responsible for the therapeutic effects these plants possess. Looking into the history of medicinal plants all around the world shows the potential uses of the medicinal plants present in the Maltese Islands. It also highlights the distinction between developed and underdeveloped countries and their reliance of medicinal plants for animal health, and ultimately, public health. The main plants discussed in this review are Caper Bush (*Capparis orientalis/Capparis spinosa subsp. repestris),* the Olive tree (*Olea europaea subsp. europeae),* the Common Hawthorn *(Crataegus monogyna/Crataegus oxyacantha),* Vervain *(Verbena officinalis),* Stinging nettle *(Urtica dioica),* Ivy *(Hedera helix/Hedera taurica),* Pennyroyal Mint *(Mentha pulegium),* Tree tobacco *(Nicotiana glauca),* Pot Marigold *(Calendula officinalis),* Lemon Balm *(Melissa officinalis),* Garlic *(Allium sativum),* Common Sage *(Salvia officinalis),* and True Aloe *(Aloe vera/Aloe barbadensis).* For each of these plants, the ethnoveterinary aspects in several countries are listed and where known, the major plant-derived constituents are mentioned, and their effects discussed.

7. Összefoglalás

A dolgozat a gyógynövények fontosságát tárgyalja. Betekintést nyerhetünk a növényi anyagcseretermékekbe és a belőlük levezethető fő hatóanyagcsoportokba, melyek felelősek az alkalmazott terápiás hatásokért. Áttekintést nyújt a gyógynövények történetiségéről világviszonylatban, és bemutatja a Málta szigetek jelenlegi, aktuálisan használt gyógynövényeit. Kiemeli továbbá a fejlett és a harmadik világ országai közötti különbségeket a gyógynövények alkalmazásának tekintetében, hozzáállásukat az állategészségügy és az álltalános egyészségügy viszonylatában. A dolgozat a következő növényeket tárgyalja: tövises kapri (*Capparis orientalis/Capparis spinosa subsp. repestris*), olajfa (*Olea europaea subsp. europeae*), egybibés galagonya (*Crataegus monogyna/Crataegus oxyacantha),* közönséges vasfű (*Verbena officinalis*), nagy csalán (*Urtica dioica*), közönséges borostyán (*Hedera helix/Hedera taurica*), csombormenta (*Mentha pulegium*), dohányfa (*Nicotiana glauca*), orvosi körömvirág (*Calendula officinalis*), citromfű (*Melissa officinalis*), fokhagyma (*Allium sativum*), orvosi zsálya (*Salvia officinalis*), Aloe fajok (*Aloe vera/Aloe barbadensis*).

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9. Acknowledgements

I would like to thank my supervisor, Dr. habil. Péli Evelin Ramóna, for all her help and guidance throughout this writing process.

I would also like to acknowledge the Ministry of Education and Employment, as part of the Government of Malta, who have supported my studies and this review by means of the Veterinary Studies Scholarship Scheme (VSSS).

Lastly, I thank all my family and friends who have stood by my side throughout the entire process, not only while writing this review but through my entire veterinary studies. This goes especially to my mother, Jane, who has offered love and support and been my rock for as long as I can remember. Without her, all I have done would not be possible!

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