Herbal Medicine for the Treatment of Mycoplasma Pulmonis in Rats

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A Note to the Reader

During my research on Mycoplasma pulmonis in rats, I discovered that it was important to show how everything in the body is connected. Organs and cells are not completely isolated from each other, and diseases working through the body’s system are no different. Although certain disease processes are specialized in their choice areas of the body, there is no magic wall that completely separates them from the rest of the body.

I spoke with a lot of people about M. pulmonis throughout this project, and whether they were medical professionals or people interested in helping rats in rescue and volunteer scenarios, I came across tremendous resistance. Although all of us were still working toward the same goal, it became clear that I was pursuing a way of thinking about this disease that was outside of the box and outside of most people’s comfort zone. There were times I experienced a lot of doubt in myself and in this process, but sometimes it’s necessary to step off the beaten path.

I remember seeing a photo of the very first rat I adopted, who I named Awe:ri. She had a little brown heart shaped patch of fur on her back. The moment I saw her, I knew that she was family. Awe:ri brought with her a sister, Ohna’, who was a cute little pink hairless rat also in need of a
home. Life inspired by them has become an irrevocable journey and watching the painful progression of this disease in my family is something that has motivated me to do my best to learn more. My hope is that one day we will find a cure.

Awe:ri and Ohna’ have been two of my biggest teachers in learning to love fully, and to trust unconditionally. They are the reason that I am pursuing the truth in spite of opposition. Their names mean “heart” and “skin.” It’s all connected from the inside out.

Abstract

*Mycoplasma pulmonis* are in the Mollicutes class of bacteria and primarily occur as a respiratory infection in rats and mice. They have evolved over time, shedding genomes such as those programmed to create a cell wall, to become small, flexible, and therefore extremely adaptable. The host becomes their factory, supplying the remainder of functions required to exist and provide the nutrients essential for their survival. This relationship is very biased and mostly parasitic. If not treated from a wide range of aspects, it’s the host that ultimately suffers.

*M. pulmonis* is not just a respiratory issue, the bacteria also has an affinity for joints and the reproductive system. This disease will persist and spread, extracting what it requires to survive at the expense of the host. Eventually, once depleted of nutrients, the host’s immune system is no longer able to function optimally. Also, upon detection of the intruder, the host initiates an inflammatory response that eventually exacerbates the issue and potentially leads to more obstacles down the road. Studies have shown that a healthy and uncompromised immune system
allows the body to effectively eliminate pathogens before they can infiltrate, making immunology a primary focus in the research of *M. pulmonis*.

This is a complex disease requiring a complex treatment. Whole plants contain multiple constituents that offer a more diverse solution than the current antibiotic regime, which only suppresses rather than treats the big picture. By treating holistically, there are more opportunities to defend against the full capabilities of this disease with plants that have multiple constituents, providing an incredibly well-rounded medicine.

**Introduction**

*Mycoplasma pulmonis* is primarily a murine specific pathogen (Strait and Madsen 288) that can cause acute or chronic issues in the joints, respiratory, and reproductive systems (Simmons, Denison, and Dybvig 6846). However, it is mostly associated with manifestation in the lungs (Buhner, “Healing” 35). Medical intervention is commonly pursued when abnormal audible sounds occur, varying from wheezing to choking. Antibiotics are the typical pharmaceutical treatment protocol prescribed once symptoms have set in, but this only suppresses the bacteria. It does not provide a cure (Kahn 1009).

The respiratory aspect of *M. pulmonis* is what practitioners mainly treat. There does not appear to be any current conventional veterinary exploration into the complexity and depth of this disease, leading to an apparent disconnect in understanding the wide range of body systems that can be involved in the progression of *M. pulmonis*. 

Research shows that the immune system and its inflammatory responses play a large role in *M. pulmonis* (Razin, Yogev, and Naot 1123). There have also been studies done confirming the connection of *M. pulmonis* to issues of the reproductive system and joints, two other concerns that arise in domestic rats (Simmons and Dybvig 5733).

The missed opportunity in finding a more efficient treatment protocol has been in treating isolated body systems and not the patient as a whole. Everything is connected and is made apparent by carefully observing the progression of this disease, and by the extensive research done on *M. pulmonis* both in vivo and in vitro. A holistic approach to *M. pulmonis* in both the research and the treatment offers the opportunity to step a bit farther back and look at the big picture.

**Overview of Mycoplasma pulmonis**

Mycoplasmas are the smallest known self-replicating organisms (Razin, Yogev, and Naot 1096), classified as Mollicutes in the order Mycoplasmatales (Strait and Madsen 283) and in the family Mycoplasmataceae (Buhner, “Healing” 21). Based on their common biological properties, it is presumed that these distinctions allow most mycoplasma species to share similar actions in the host (Kim et al. 219). It causes similar disease in both plants and animals (Buhner, “Healing” 21). *Mycoplasma pulmonis* specifically is a widespread murine bacterium, primarily in rats and mice (Strait and Madsen 288).
Mycoplasmas are descendants of the *Streptococcus* branch of the bacterial kingdom and date back around 600 million years (Razin, Yogev, and Naot 1122). All these years of evolution have made their adaptation skills extremely intelligent and resilient; mycoplasmas lack a cell wall, as confirmed by chemical analysis and electron microscopy. They contain only a cytoplasmic membrane, making them very flexible and able to take on many different shapes (Madigan and Martinko 384). Despite lacking a cell wall, they are still considered to be Gram-positive organisms (Buhner, “Healing” 19). There have been over 200 mycoplasma organisms discovered. Deoxyribonucleic acid (DNA) indicates that they branched off from their Gram-positive ancestors, shed their cell wall, and began reducing their genome size (Buhner, “Healing” 19).

Due to their physical size limitations, mycoplasmas needed to attempt a very symbiotic relationship with their host in order to acquire most of the nutrients they require to thrive (Minion 394). Mycoplasmas prefer the protection of the host’s environment, and so generally in the beginning, they replicate very slowly, gradually taking only what it needs. Initially, it leaves the host in a very mild and chronic state (Razin, Yogev, and Naot 1106). The importance of this relationship has been demonstrated when efforts to cultivate mycoplasmas in laboratory settings have proven difficult; attempting to replicate the same nutrient-rich setting in vitro has only ever been somewhat successful (Razin, Yogev, and Naot 1100). Mollicutes cannot synthesize amino acids, and cannot, or can only partially, synthesize fatty acids relying on the host to provide these nutrients (Madigan and Martinko 284). More than two-thirds of mycoplasmas membranes are made up of proteins, and the remaining are lipids (Buhner, “Healing” 59). These are extremely important in the survival and co-evolution of mycoplasmas with their host, as both are key
nutrients scavenged and then used when generating antigenic variation, a system used to avoid the host antibody attack (Razin, Yogev, and Naot 1146).

Variable Surface Antigens

Antigenic variation or variable surface antigens (Vsa) are vital in *M. pulmonis*’ continual evasion of the immune system response, and this contributes to its persistence in the host (Simmons and Dybvig 5733). *M. pulmonis* evokes an inflammatory response in the joints, respiratory, and reproductive systems, both acute and chronic (Simmons, Denison, and Dybvig 6846). By altering its surface antigens quickly, *M. pulmonis* is able to avoid detection by the host’s immune response and shield its membrane from lysis (Shaw, Simmons, and Dybvig 704). Although mycoplasmas do not have a cell wall and this lack of armor should leave them even more susceptible to lysis, they have evolved to increase the amount of antigenic variation, making them highly resistant to complement killing (Simmons, Denison, and Dybvig 6846). As many as 60 tandem repeats can be used to evade detection by the hosts immune system (Shaw, Simmons, and Dybvig 704). A large portion of mycoplasmas’ small genome size is designated to this antigenic variation system, reflecting the extreme importance of this function (Razin, Yogev, and Naot 1145).

Immune System

It is important to understand the role of the complement system, an aspect of the immune system that plays a part in both destroying the pathogen and increasing inflammation (Roiger 426). In a
healthy immune system, there are multiple defense mechanisms triggered to protect the host, including recognition of the pathogen and responding to the Vsa system, alveolar phagocyte opsonization, and alveolar macrophage clearing of *M. pulmonis* in the lungs (Simmons and Dybvig 5737).

Attempts to rid the body of the bacteria triggers an inflammatory response, and if the immune system is not able to detect the pathogen, the inflammation continues and becomes largely responsible for the chronic nature of the disease, and eventually the development of pulmonary lesions (Simmons and Dybvig 5736). Ciliostasis and damage to the respiratory epithelial cells occur initially by *M. Pulmonis*, but over time it is exacerbated by the host’s continual inflammatory response (Stadtländer et al. 4201).

As well, many studies have shown a direct link between immunosuppression and depletion of nutrients caused by mycoplasmas (Razin, Yogev, and Naot 1130). Over time, mycoplasmas will continue to scavenge nutrients from the host wherever and however it can, commonly leading to lethargic wasting (Buhner, “Healing” 63). By replenishing the many nutrients scavenged by *M. pulmonis*, reducing the inflammatory process, and building back the immune system healing is possible, but it does take time (Buhner, “Healing” 117).

It therefore cannot be stressed enough that a healthy, fully functional immune system is key in resistance against *M. pulmonis*; when operating in peak performance, all aspects of the host’s immune system are working together to ensure multiple defense tactics (Simmons and Dybvig 5737).
Progression of Mycoplasma pulmonis

Respiratory

Murine respiratory mycoplasmosis, which is caused by *M. Pulmonis*, can be both acute and chronic (Simmons and Dybvig 5733). The acute phase is associated with large amounts of neutrophils and edema in terminal airspaces and is often fatal, whereas the chronic phase is associated with peribronchial accumulations of lymphocytes (Simmons and Dybvig 5733).

Typically, the first sign of stress or respiratory disease begins with chromodacryorrhea, a red staining around the nose and eyes originating from the Harderian glands located behind each orbit (Mason et al. 153). The gland contains secretory products such as lipids and melatonin, but it’s the porphyrins that are responsible for the reddish color that has the appearance of “bloody” tears (Mason et al. 153).

Another more serious sign that *M. pulmonis* has infiltrated the respiratory system is an audible noise that develops, sounding like a whistle or a wheeze. It is usually at this stage where I bring my rats to the veterinarian and antibiotics are required, unless the doctor feels something else may be going on and further testing needs to be done. Even with antibiotics, I have seen it progress relatively quickly, where within days the rat will display signs of accessory muscles being used when breathing. Other times, I have seen the alternative where a rat that is not on antibiotics may show minor signs of *M. pulmonis*, however the progression has taken months. In some cases, if not diagnosed properly, if the correct dosage of the antibiotic is not given, or if old
age is a factor, *M. pulmonis* can quickly turn into respiratory crisis and I have had rats that required oxygen therapy.

Regardless, every rat is different, and I reserve the use of antibiotics only when needed, as antibiotics build tolerance. It’s important to use only when appropriate (Whalen 478). Treatment with antibiotics is usually recommended for 30 days, and two of the most commonly prescribed are doxycycline (Plumb 368) and enrofloxacin (Plumb 382).

At this time, *M. pulmonis* is currently not curable. Repeat treatments and sometimes even a lifetime of continuous antibiotic use is typical for most rats once they begin to show signs (Kahn 1009). Occasionally, if there is excessive respiratory congestion and breathing becomes very labored, then Theophylline, a bronchodilator can be used. It should be used with extreme caution as fluoroquinolones such as enrofloxacin can considerably increase the levels of Theophylline (Plumb 1013).

Reproductive

Mycoplasmas can severely impact the reproductive system, have a “strong affinity for mammary glands,” and can cause inflammation (Buhner, “Healing” 90). Rats often develop mammary fibroadenomas that can grow quickly; these normally benign tumors are quite common in both male and female rats, and although they can be surgically removed, recurrence is an issue (Kahn 1012). Although there has been extensive research linking females rats that have not been spayed to excess estrogen and mammary tumors, as with any disease in both animals and humans, a
multitude of causative factors can lead to tumor growth (Durbin et al. 400). In the case of *M. pulmonis*, a great deal of stress and immune suppression can increase the likelihood of mammary tumor development and metastases by decreasing immune function, the release of antibodies and natural killer (NK) cells (Ben-Eliyahu et al. 193). I have observed that mammary tumors are a common occurrence within the months following a diagnosis of *M. pulmonis*. Being aware of the body as a whole, and how this disease affects it, is an important aspect that is seldom considered. In more a more severe case of *M. pulmonis*, I have seen vaginal bleeding that could not be explained by a veterinarian. When looking at the bigger picture, it’s not just about *M. pulmonis* targeting the respiratory tract. It is also important not to dismiss how it also has a predisposition for the reproductive tract and the joints as well (Simmons, Denison, and Dybvig 6846).

**Joints**

It, therefore, is no surprise that arthritis is another issue I’ve observed with rats, typically in the very final stages of *M. pulmonis*. Upon further research, I found many studies linking the two. One in particular showed that those previously infected with *M. pulmonis*, are equal or more susceptible to *Mycoplasma arthritidis* induced arthritis (Cole, Golightly-Rowland, and Ward 1090). Another demonstrated how “M. pulmonis organisms play a critical role in the development and persistence of M. pulmonis induced arthritis” (Keystone et al. 355).

Another observation was that the severity of the arthritis directly corresponded with the number of *M. pulmonis* organisms in that joint (Keystone et al. 356). Further examination is being done into the growth of *M. pulmonis* during the acute phase; although it can be eventually cleared
from the organs, it remains chronic in the joints, suggesting the bacteria favor those sites (Keystone et al. 356). An explanation for this could be that the disease may affect the nutrient rich synovial tissue in joints; once the inflammation is triggered by the presence of M. pulmonis, the tissue breaks down and releases a protein-rich fluid (Buhner, “Healing” 87). Maintaining direct contact and permanent residence in the joints fulfills the continual demand for these required nutrients (Minion 394).

Basic understandings of the nutritional requirements of the organism and the host are important. These need to be continually replaced in order for the host to avoid depletion, however, it’s important to note, “this will not ‘feed’ the mycoplasmas” (Buhner, “Healing” 115) and is essential in treating this disease. The nutrients that are scavenged by all the mycoplasmas are: B vitamins, choline, zinc, copper, selenium, amino acids, and fatty acids, and can be replenished by supplement or food as long as the recommended daily intake requirement is met (Buhner, “Healing” 120-125).

What I would like to stress the most, based on both personal experience and intensive research, is the importance of keeping an open mind regarding the bigger picture of M. pulmonis. This is a very complex condition, so I don’t believe it should be treated as just a respiratory illness. M. pulmonis is a very intelligent bacteria that can, and will, consume so many host nutrients due its small genome size. This inability to produce most nutrients themselves is a tradeoff that allows for its flexible shape, infiltration, and adaptation abilities, but causes a chain of events that alone can initiate a whole series of issues. Inflammation also plays a large role in M. pulmonis and so this must be addressed, as well. It must be logically addressed and treated from many angles,
including immune, respiratory, reproductive (especially in terms of tumor formation), joint and nutrient health.

**Pharmaceutical Treatment**

Currently, there is no cure for *M. Pulmonis*, but antibiotics can be used to treat the symptoms (Kahn 1009). Two that are commonly prescribed by many veterinarians, and I have used in the past for my rats, are doxycycline and enrofloxacin.

Doxycycline is a tetracycline antibiotic that inhibits protein synthesis and the most common adverse effects occur in the gastrointestinal tract (Plumb 365) such as nausea and indigestion (Raman-Wilms 268). This may be caused by the elimination of naturally occurring bacteria in the colon and it has been shown in studies that supplementing with probiotics can help alleviate this issue (Gaby 101). It is important to be aware that doxycycline is contraindicated in pregnant or young rats (Plumb 368).

Enrofloxacin is typically used alongside doxycycline as a fluoroquinolone antibiotic that inhibits DNA synthesis (Plumb 379). There are also adverse effects in the gastrointestinal tract with this antibiotic, such as diarrhea (Plumb 382). I have found it beneficial to include probiotics as part of the treatment plan, especially when both antibiotics are prescribed. For rats that are especially sensitive to antibiotic related dehydration causing excessive loose stools, I have found coconut water in place of their regular drinking water to be important for quick rehydration. It is
imperative to note that enrofloxacin is contraindicated for younger rats that are still growing (Plumb 379).

Both antibiotics are prescribed based on weight, so dosages will vary but they are generally given orally twice a day for 30 days, however, the mg/kg can also vary (Plumb 368, 382). In my experience, it all comes down to differing opinions from veterinarians as to what the proper strength should be. It should be considered that enrofloxacin is known to have central nervous system effects, and this is why it is no longer used for human consumption (Plumb 379). There have been two specific occasions where I have observed adverse effects to enrofloxacin. One case was fatal. In my opinion, this warning is not stressed enough or even acknowledged appropriately when prescribing enrofloxacin.

Theophylline is a bronchodilator that directly relaxes smooth muscles in the bronchi and pulmonary vasculature (Plumb 1013). It is prescribed alongside antibiotic treatment in rats that are experiencing more severe respiratory distress with *M. pulmonis*. Enrofloxacin can increase theophylline in blood levels by up to 30% (Plumb 381, 382) and it has a very narrow therapeutic window, so dosages must be determined very carefully (Plumb 1014).

Meloxicam, better known in the rat communities by its trade name Metacam, is a non-steroidal anti-inflammatory (Plumb 675). It is typically given to rats as a post-op take-home oral pain medication. A lot of rat caregivers also know of this pharmaceutical for other reasons, as it is very often prescribed when *M. pulmonis* progresses into the later stages and pain management can increase a rat’s quality of life. In every case that my veterinarian prescribed it, arthritis had
set it. Meloxicam is very effective, but does not treat the underlying condition (Raman-Wilms 342).

These pharmaceuticals can be lifesaving in some cases, but will never resolve the underlying pathology. As with all pharmaceuticals, it’s important to know when they are required and to use as instructed, as they do have risks and side effects.

**Herbal Treatment**

NOTE: I have found the following herbs to be completely safe when being used along side *M. pulmonis* pharmaceutical treatment plans. I did, however, find one mention of a “potential interaction” with *Ganoderma lucidum* and antibiotics (see Safety & Dosage). I have personally not found this to be a concern, nor could I find any other research supporting this claim. I have also used these herbs with healthy rats not experiencing *M. pulmonis*; in fact, I have found it has increased their resistance to *M. pulmonis*. I have never used these herbs with a pregnant rat so be advised there is a known veterinary contraindication with *Marrubium vulgare* (see Safety & Dosage). It can however be easily removed from the formula. Please also see Safety & Dosage for all additional herb-drug interactions and contraindications. Specific dosage information is provided in the appendix.

In order to target something as complex as *M. pulmonis*, several angles need to be addressed. Focusing on just one aspect will not yield the desired effect. It’s important to work on immunity, the respiratory system, inflammation, vitamin and mineral deficiencies caused by *M. pulmonis*,
and overall healthy dietary requirements. I have also found that herbs with multiple therapeutic actions can influence many areas of the body affected by *M. pulmonis* and simplify the treatment protocol while still being effective and making compliance that much easier.

Extraction method is an issue that I have found challenging yet important to take into consideration in the treatment of *M. pulmonis*. Although I have used dried and fresh herb decoctions and infusions, alcohol tinctures and powders, I have found the most success and compliance with a mix of methods. As a Fundamental Herbal Formula, I use a decoction of dried *Echinacea angustifolia* RAD (radix/root) combined with an infusion of dried *Verbascum thapsus* FOL (folium/leaf) and *Marrubium vulgare* FOL (folium/leaf) added to the rat’s main water source, and *Ganoderma lucidum* (whole mycelium and fruiting body powder) added as a sprinkled topping on food it can stick to such as rice. It can also be mixed into a paste with a ripe banana, coconut yogurt, avocado, or coconut oil. One of the main benefits of having a majority of the fundamental herbs in the rat’s water is that they are continually being ingested throughout the day and night.

Every rat is unique, and like humans, each has individual palates. I have experimented with different ways to incorporate the medicine into their daily routine, and there have been times I have had to vary the form in which the medicine is given. Adapting the medicine to their personal taste preference leads to less stress when administering and in the long term I have found this important in the healing process. In acute stages of infection, it’s especially important to dose frequently, however, if herbs of the Fundamental Herbal Formula are to be used in tincture form, one source advises that they cannot be combined and must be dosed singly (Wynn
and Fougère 541, 582, 604). No reason was given for this rationale and I have personally not seen this to be an issue.

The various extraction methods will yield different constituents and in differing strengths. As a result, many herbalists emphasize scientifically preferred choices in extraction method (Green 74, 75). However, I have found that compliance is the most important factor to take into consideration. Some extractions may be more beneficial from a key constituent perspective, but ultimately I have found that however the rat will consume the herbs with the least amount of stress is the preferred way to deliver the treatment. Overall, I prefer to approach treatment with the plant as a whole and not focusing on identifying one constituent as being key. I believe the entire plant has evolved with intelligent design, and that all aspects are essential and working together to achieve a unison. A book entitled Veterinary Herbal Medicine quite eloquently said it best - “The plant is the active constituent” (Wynn and Fougère 3).

Immune

Based on both research and personal experience, maintaining a solid immune system is key to addressing M. pulmonis. The two herbs I have had the most success with are E. angustifolia decocted and combined with the rat’s daily water and G. lucidum added to food. In the case of E. angustifolia, there has been much discussion as to the active constituent responsible for its effects on the immune system. The two that seem to be attracting the most attention and research are alkylamides (responsible for the tingling sensation on your tongue) and polysaccharides (Wynn and Fougère 92). An interesting find regarding alkylamides showed that low oral doses
increased phagocytic activity and the phagocytic index of alveolar macrophages in rats (Wynn and Fougère 94). Again, compliance is the most important aspect to consider in treating *M. pulmonis*, extraction method or specific constituents are secondary. I have found with experience that as long as the herbs are consumed, the medicine is being delivered.

Important actions of *E. angustifolia* are that it is also an anti-inflammatory and inhibits tumor growth (Hounslow 2), and both have been shown previously to be two key links in *M. pulmonis*. It is also antimicrobial and a natural non-toxic antibiotic by being able to stimulate killer cells (Bartram 161). Protective effects of *E. angustifolia* have been shown in a study where mice received daily doses throughout their lives and demonstrated significant longevity and immune function (Wynn and Fougère 539). With the additional connection to *M. pulmonis* and arthritis, it is worth noting that it has been used to reverse various forms of arthritis and rheumatism (Herbal Antibiotics 278). Using herbs that target multiple aspects of *M. pulmonis* widen the healing spectrum, allowing for compliance and ease of treatment for both the caregiver and the rat.

Another great herb for immune health is *G. lucidum*. Laboratory studies of its active polysaccharide (mycopolysaccharide) have shown a wide range of increased immune response measures and increased phagocytosis; it’s believed that β-glucans, their main bioactive substance, are responsible for the immunomodulatory effect of many medicinal fungi (Hoffmann 153). Again, although active constituents have been found to be key contributors, “the herbs act as biological wholes, not just as vehicles for active ingredients” (Hoffmann 443). I have found the easiest way to deliver *G. lucidum* is in powder form and mixed in the rat’s favorite, healthy foods. Both *G. lucidum* and *E. angustifolia* are to be given daily, and so it’s important that this is
enjoyable for them. As discussed earlier, stress can lead to adverse effects when the body is dealing with *M. pulmonis* and so another important aspect of *G. lucidum* worth noting is its use as a parasympathetic nervous system tonic to help support the rest and digest state (Wood 272). It is also interesting that *G. lucidum*, like *E. angustifolia*, also enhances natural killer cells and is antibacterial and antitumor (Herbal Antibiotics 304).

**Respiratory**

A fantastic lung herb for irritable respiratory conditions is *V. thapsus* (Bartram 299) and I have found this plant to be key in treating *M. pulmonis*. Not only does it tone mucous membranes, it also reduces inflammation (Hoffmann 592). Its antibacterial properties have been observed in vitro especially when prepared as a water extract (Wynn and Fougère 602). It is important to note that the leaf hairs can sometimes cause irritation if not strained properly, and so a fine strainer should be used when infusing *V. thapsus*. As mentioned previously, antibiotic treatment may cause gastrointestinal upset, and *V. thapsus* is also helpful in treating the possible side effect of diarrhea (Hounslow 3), which can quickly lead to dehydration. I have used coconut water mixed with the fundamental herbs (which includes *V. thapsus*) when there are loose stools during antibiotic treatments and this has been successful in rehydration.

In addition to *V. thapsus*, I also include a second respiratory herb, *M. vulgare*, in the Fundamental Herbal Formula. Its veterinary indications are primarily chronic pulmonary conditions (Wynn and Fougère 581), so I have found this an excellent choice for *M. pulmonis*. It is a soothing tonic for mucous membranes (Caudwell 2), addressing the irritation caused by the
inflammation of the mucosa (Stadtländer et al. 4201). Although it’s extremely bitter (Herbal Antibiotics 373), I have found that rats love the taste of it and aside from having this herb mixed in with their daily water source, will even drink it as an undiluted strong infusion.

Reproductive & Joints

The Fundamental Herbal Formula has been devised to be proactive against *M. pulmonis* by addressing all potential target areas caused by this disease. The formula contains herbs that offer immune support, which is important to address in regards to stress and tumor formation in the reproductive system (Ben-Eliyahu et al. 193), and anti-inflammatories that help control the process initiated during synovial invasion of *M. pulmonis* in the joints (Buhner, “Healing” 87).

Ultimately, the daily Fundamental Herbal Formula treatment plan is a decoction of dried *E. angustifolia* RAD added to an infusion of dried *V. thapsus* FOL and *M. vulgare* FOL in a rat’s water source, alongside powdered *G. lucidum* sprinkled on or mixed in with food. Although there are not very many herbs being used, I specifically chose ones that were able to work on the many different issues that arise from *M. pulmonis*.

The final addition to the overall treatment plan is ensuring that the following vitamins, minerals and nutrients are met: B vitamins, choline, zinc, copper, selenium, amino acids, and fatty acids. This can be met through diet or supplementation, and are important because these are frequently scavenged by *M. pulmonis* and need to be replaced. Again, with each rat having their own food preferences, it is important to be familiar with the nutritional breakdown of their typical diet to
ensure these are all met daily. If they are not being met, I have found it quite easy to add any of these supplements into a smoothie with some fruit and greens and they are quite happy to enjoy this as a healthy snack. I have found no data on specific dosages for rats for supplementation, so I make a smoothie with the recommended human daily dosages for myself and give them a rat-sized portion.

There has been a lot of information gathered from rat testing that makes our lives safer and healthier, but unfortunately not a lot of research has been directed towards improving their quality of life. Herbal in vitro studies are not very reliable, as a petri dish will never be able to replicate accurately what would happen in vivo. There are a few things I have found that have worked for me. I strive to find as much information as possible, use my intuition and common sense, and start slowly with herbal treatment. Introducing healthier and safer alternatives to pharmaceutical treatment when done with care is possible, and I have only seen positive outcomes. I would never disregard pharmaceutical treatments when they are needed. I have been very grateful for them as they have saved lives in otherwise fatal situations and given me more precious time with my rat companions. I think a healthy respect for both, and knowing when each is appropriate is key.

**Safety & Dosing**

Modern veterinary herbal medicine posology is very limited, but prior to pharmacology as we know it today, herbs were much more prevalent in medicine. Books published from 1860 to 1950 are some of the best resources for dosing (Wynn and Fougère 232), if you can find them.
Although there are many herbs that are safe and user-friendly, adverse reactions and toxicity can occur with inappropriate dosing (Wynn and Fougère 232). Seeking the advice of a qualified medical herbalist is recommended.

There are many factors to take into account when dosing: contraindications, herb-drug interactions, knowledge of the daily/weekly maximum dose of each herb, quality of the herbs, extraction method, route of administration, absorption, frequency, age, and overall condition of the patient (Wynn and Fougère 232). Something else to take into consideration is that herbs work on both physical and energetic levels, so the individuality of the patient must be considered (Wynn and Fougère 232). There is always the option to start with a smaller dose, especially with smaller animals, and work upwards if needed, as a way to build a relationship with each herb and to get a feel for every individual patient-herb interaction (Wynn and Fougère 232). Plants are alive just as we are. This spiritual dynamic must be respected.

Acute and chronic conditions are also treated and dosed differently (Wynn and Fougère 232). For an acute scenario, stronger herbs can be used and dosed every two-to-four hours until the symptoms subside; however, if there is no change the herbs may need to be reevaluated (Wynn and Fougère 232). For chronic conditions, as is usually the case with *M. pulmonis*, a formula can be given for weeks or months and as the condition changes, the herbs may need to change (Wynn and Fougère 232). If there are any adverse reactions, the herb(s) should be discontinued and if appropriate, brought back at a lower dose (Wynn and Fougère 232). If herbs are being used long-term, one source recommends that rest days be taken (Wynn and Fougère 232). For chronic *M. pulmonis*, I will dose five days on of the Fundamental Herbal Formula, and two days off. My
understanding and personal experience working with herbal medicine is that plants reset or re-teach the body how to function optimally. Giving this break allows the body to apply what the plants have been demonstrating within our system.

There have been times during an acute episode of *M. pulmonis* where I have used alcohol tinctures of the fundamental herbs. I have found a lot of rats do not enjoy the taste and so compliance has been an issue. Because of this, I tend not to use them very often and favor the decoction/infusion/dried herb combination, but consistency is the key. In my experience, if it wasn’t caught early enough and *M. pulmonis* is deep into the lungs, the herbal treatment may take a while. This is usually the case with rats that are rescued from poor living conditions. I will continue the entire Fundamental Herbal Formula until there have been two solid weeks without unusual respiratory sounds or excessive porphyrin discharge. After two weeks of clear breathing, it would be ideal to continue with both the decoction of *E. angustifolia* in the main water source, and the dried powered *G. lucidum* added to food (five days on, two days off). This will offer continued immune support. If at anytime respiratory sounds resurface, the entire Fundamental Herbal Formula can be reintroduced.

**Small Animal Dosage Range for the Fundamental Herbs**

(Wynn and Fougère 541, 604, 582)

**E. angustifolia**

Decoction: 5-30g per cup of water, administered at a rate of ¼-½ cup per 10kg

**V. thapsus**
Infusion: 5-30g per cup of water, administered at a rate of ¼-½ cup per 10kg

*M. vulgare*

Infusion: 5-10g per cup of water, administered at a rate of ¼-½ cup per 10kg

**Additional Veterinary Contraindications**

(Wynn and Fougère 540, 604, 582)

*E. angustifolia* – Asteraceae family allergies

*V. thapsus* – None known

*M. vulgare* – Pregnancy

**Potential Veterinary Drug-Herb Interactions**

(Wynn and Fougère 198, 201, 203)

*E. angustifolia* – Chemotherapeutic agents, econazole, immunosuppressants

*M. vulgare* – Antihypertensives, insulin, oral hypoglycemic agents

*G. lucidum* – Acyclovir, anticoagulants, antihypertensives, antibiotics, cefazolin, immunosuppressants, insulin and oral hypoglycemic agents, interferon

I have not found any properly documented veterinary dosages or contraindications for *G. lucidum*, however, a monograph for human consumption suggests 20-27g of dried herb per day (Caudwell 5). I have safely been using *G. lucidum* with all my rats by giving them each ½ tsp per day (half in the morning and half at night) in their favorite food.
Conclusion

It has been known since Alexander Fleming discovered antibiotics in 1928, that bacteria would become resistant if we misused them. Here we are today, with scientific predictions and warnings of a very near future without them. The intelligent nature of bacteria such as *M. pulmonis* shows us the complexity of the issue. The problem must be modulated by something equally as intelligent and sophisticated. This is where herbs, which are comprised of more than just one active constituent when used whole, offer a more well-rounded and complete medicine.

In order to make new solutions, we must throw out old ways of thinking, and this includes compartmentalizing diseases, body systems, and treatment. *M. pulmonis* is much bigger and much more complex in comparison to how it is currently being managed. We need to dig deeper, ask more questions, and approach treating an intelligent disease with an intelligent medicine. Herbal medicine has a depth and intricacy that makes it uniquely equipped to take on this challenge.

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Scoring Chromodacryorrhoea.” Alternatives to Laboratory Animals 32.1 (2004): 153-159. Print

McVey, D. Scott, Melissa Kennedy, and M.M. Chengappa, eds. Veterinary Microbiology. 3rd ed. 

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The following is a simple resource for the Fundamental Herbal Formula, as well dietary suggestions, additional reading and online herbal stores in both Canada and the United States. No formal citations have been used, but all detailed information can be found in the body of the research paper. The following amounts are based on dosages for two rats, with an average weight of 500g each.

Fundamental Herbal Formula

**Ingredients**

3 cups Water

15g (2 tbsp) *E. angustifolia* RAD (Echinacea root)

5 g (4 tbsp) *V. thapsus* FOL (Mullein leaf)

5 g (2 tbsp) *M. vulgare* FOL (Horehound leaf)

**Directions**

- Bring water to a boil
- Add Echinacea and let simmer covered for 13 minutes
- Add Mullein and Horehound and simmer covered for 2 minutes
- Turn off stove and let it cool covered
- Use fine strainer/filter to remove liquid (plant matter can be composted)
- Medicine can be placed in a mason jar with lid on and kept in fridge for 5 days
Add 15ml (1 tbsp) to rat’s fresh water source in the morning, and then again in the evening. If the water is being dispensed from a water bottle and if it’s being changed once a day, then add the full amount 30ml (2 tbsp). These numbers are calculated on the lower end of the daily amount, and so more can be added if needed. They also will not likely drink the entire amount each day, so there is room to increase as needed. If they enjoy the taste and will drink it, it’s ideal if the formula can be dosed directly from the tablespoon. In acute cases of *M. pulmonis*, an additional tablespoon can be given directly by mouth daily as well as the regular amount added to the water.

As part of the Fundamental Herbal Formula, ½ tsp of *G. lucidum* (Ganoderma) powder should be given to each rat daily. It can be added to wet food or healthy snacks and split into a morning and evening dose if needed.

**Examples of administration**

- As a sprinkled topping on food it can stick to such as rice
- Mixed into a paste with ripe banana, coconut yogurt, avocado, or coconut oil

**Supplements**

B vitamins

Choline

Zinc
Copper
Selenium
Probiotics (when on pharmaceutical antibiotic treatment)
Omega 3
Coconut water for dehydration

Resources

**Canadian Herbal Suppliers**
Harmonic Arts (Courtenay, BC)
www.harmonicarts.ca

Gaia Garden (Vancouver, BC)
www.gaiagarden.com

**American Herbal Suppliers**
Zack Woods Herbs (Hyde Park, VT)
www.zackwoodsherbs.com

Mountain Rose Herbs (Eugene, OR)
www.mountainroseherbs.com

Pacific Botanicals (Grants Pass, OR)
Additional Reading Material

*Healing Lyme Disease Coinfections: Complementary and Holistic Treatments for Bartonella and Mycoplasma*

Stephen Buhner

*Veterinary Herbal Medicine*

Susan G. Wynn, Barbara Fougère

*Plumb’s Veterinary Drug Handbook*

Donald C. Plumb

*Medical Herbalism: The Science and Practice of Herbal Medicine*

David Hoffmann