

The Truth About Pine Shavings

By Corinne Fayo

“We sell lots of pine and cedar to be used as small animal bedding and have never had a report of anyone's animal getting ill as a result!” -Howard McMurrian, President GEM Shavings & Sawdust Co.

This article has been reviewed by Carol Green a rabbit breeder with a Ph.D. in Pharmacology and Toxicology, her area of research is drug metabolizing enzymes and she has more than 80 publications in the field. She said the article is accurate.

And by a medical doctor & research writer who had studied the HME system for six months. Her comments to me were; "If all the phenols do is to induce some of the microsomal enzymes, that's nothing to be concerned about."

The great pine/cedar debate has been raging on the internet for quite awhile and many people have been misled about the use of softwood (pine and cedar) bedding for small animals. Many people have been spreading incorrect, inaccurate information and have misinterpreted several scientific studies. Actually reading the studies and correctly interpreting them reveal there isn't a danger in using softwood bedding for animals. After reading this article you will learn that treated shavings are safe and even recommended by veterinarians, the effects untreated softwood beddings cause is not harmful to the animals, and the claims they cause problems such as liver disease, damage, or cancer are not correct.

Hepatic Microsomal Enzymes (HME)

The real "debate" is over whether or not untreated pine and cedar shavings are a danger. It has been proven that untreated pine and cedar contain an inducing agent of HME activity. HMEs are by-products of the liver after processing drugs. "It is simply the way the body-or more specifically, the liver-handles many of the elements it comes into contact with each day."(20). I was also lucky enough to run into a medical doctor/research writer who had studied the HME system for six months. Her comments to me were; "If all the phenols do is to induce some of the microsomal enzymes, that's nothing to be concerned about." She continued with "I know that there are lots of things that both induce and suppress microsomal enzymes in humans, and it's no big deal except when it causes a concomitantly administered drug to be metabolized differently. When that occurs, all you have to do is to adjust the dose of the drug appropriately." After reading the studies which are most often quoted as providing evidence untreated shavings are harmful I must state I don't see where any demonstrate a danger. What I have learned from the studies about HME is that there are many factors which can affect this sensitive system and cause an increase or decrease in activity (2,3,4). This is a partial list from one study (4): Table 1 list of factors affecting drug disposition: air exchange and composition, barometric pressure, cage design, cedar and other softwood bedding, cleanliness, coprophagia, diet, gravity, handling, humidity, light cycle, noise level, temperature, age, cardiovascular function, castration and hormone replacement, circadian and seasonal variations, dehydration, disease, fever, gastrointestinal function, genetic constitution, hepatic blood flow, malnutrition, starvation, pregnancy, sex, shock, stress..." "Dirty environments should now be added to the growing list of factors that affect the extremely sensitive hepatic microsomal system for metabolizing drugs. Among others, these

factors include, age; sex; strain; litter of origin; painful stimuli; ambient temperature; degree of crowding; time of day or season of drug administration; hormonal; nutritional; and physiological status; and type of bedding." (2)

As you can see by the factors listed many things can set off a change in HME activity. Dr Hawley's article also mentioned grapefruit juice can induce HME, as did the medical doctor I spoke to (20). So why are the scientists so concerned by HME and the inducing effects of pine and cedar? Several studies mentioned the problem of getting standardized test results in pharmacological studies (1,2,3,4). "Differences in the capacity of various beddings to induce may partially explain divergent results of studies on drug-metabolizing enzymes." (1) "These experiments offer an explanation for differences in the results of studies on drug-metabolizing enzymes in mice and rats." (1) "These numerous factors contribute to large day-to-day variations that have become a major problem impeding investigation of drug disposition and response in laboratory animals." (4) "These data suggest that commercial bedding materials differ in their ability to affect microsomal enzymes. Thus, interlaboratory variability in basal enzyme activities reported in the literature may be partly due to bedding materials used in animal cages." (19) "Pharmacological and biochemical investigations of hepatic microsomal enzymes (HME) in rodents have been plagued by large day-to-day variations in control values for these enzyme activities" (4). It seems HME activity to the scientists is actually a sort of "background noise" in their experiments, but important to note so test results can be accurately interpreted.

Do the scientists feel untreated pine and cedar should not be used in any laboratory? Not from what I have read in the studies. "Rejection of all softwood beddings because they are potent inducers of hepatic microsomal enzymes does not appear justified." (3). However in an effort to standardize certain test results it is suggested untreated softwood not be used (6). "Softwood beddings have been used, but the use of untreated softwood shavings and chips is contraindicated for some protocols because they can affect animals' metabolism (Vesell 1967, Vesell and others 1973, 1976)." (6). "White spruce may provide a relatively inexpensive alternative to hardwood for studies that require bedding that does not alter barbiturate sleeptime" (3). I think the above quotes illustrate that the inducing effect of untreated softwood shavings is important only to the scientific community in the process of studying drugs and their effects. In addition Dr Hawley writes that "Nearly every commercial laboratory today uses pine, cedar, or other hardwood beddings, except when conducting specific drug metabolism studies." (20).

I did come across an interesting result shown in several studies, accumulation of urine and feces which increase ammonia levels cause a decrease in HME activity (2,3,4). Now we all know increasing ammonia levels can cause damage in our animals. It has been associated with causing increased susceptibility to *Pasturella* infections and respiratory damage. "The present experiments reveal that drug metabolism in hepatic microsomes was inhibited when urine and feces of rodents were not removed twice daily but permitted to accumulate for 1 week. Inhibition of drug metabolism in rats kept under these conditions may arise from hepatic toxicity due to increased concentrations of ammonia (5) in such environments." (2). May I also point out that I have yet to find in a study a reference to pine or cedar causing hepatic toxicity. Dr Hawley also points out that the presence of these enzymes do not suggest there is damage to the liver (20).

I also found another study which reported that oral administration of praziquantel at a dosage of 1600 mg/kg and 2000 mg/kg caused a significant decrease in 3 drug-metabolizing hepatic enzymes (16). The rabbits who received the dosage of 2000 mg/kg all died within 10-20 hours. In another study rabbits were given aflatoxin to see the effects it would have on liver enzymes (17). None died but body weight gain was altered and again a decrease was noted in some HME, "Biochemical exploration of plasma components revealed a dose-dependent hepatotoxicity characterized by cytolysis and cholestasis." (17). And finally in a study comparing the activity of HME in

rats given single or repetitive fluke infections HME decreases were noted (18). Given this evidence I can't come to the conclusion that increased HME activity is a sign of harm being done to a small animal.

Pet owners also argue that untreated cedar and pine cause shortened barbiturate sleeptimes and that would be harmful for an animal undergoing surgery. The increased HME activity does shorten barbiturate sleeptimes in the studies (1,2,3,4) but note that the scientists were testing for this, not performing surgery. The studies have found that sleeptimes were shortest for cedar shavings compared to the softwoods (3,19). There were also differences among different types of pine bedding with white spruce not significantly different than hardwoods but longer than white pine (3). "In other studies, mice kept on pine beddings exhibited hexobarbital sleeptimes intermediate between those of mice kept on red cedar or Douglas Fir (9), and intermediate between mice kept on red cedar or ground corn cobs (10)." (3). Heat treated pine shavings have been shown not to alter sleeptime in comparison to control animals (19).

But does any of the above really affect us and our pets? I don't believe so, there are many factors which affect HME and therefore barbiturate sleeptime (2,3,4,). A study also found increased ammonia levels alter sleeptime and that lowering the room temperature lengthens sleeptime (3). The same study also showed that two different strains of mice studied had significantly different sleeptimes. Also consider this quote "No alteration in the hexobarbital concentration in the brain at the time of restoration of the righting response occurred on any of the softwood beddings tested." (1). "While sleeptimes are decreasing and the microsomal enzyme activity is increasing, the amounts of hexobarbital in the brain on awakening remain unaltered in mice put on softwood bedding; thus, the responsiveness of the receptor sites seems unaffected by softwood bedding." (1). I have not been able to find any scientific references or entries in veterinary books warning of a danger in regard to surgery when animals are exposed to softwood shavings. If altered barbiturate sleeptimes due to softwood exposure were critical during surgery I would think there would be a warning about it.

I also found an interesting section in the Harkness and Wagner book relating to injectable anesthetics in rats. It is stated that sodium pentobarbital used in rats "poses considerable risk" (7) pg.109. "Pentobarbital also has poor analgesic properties in rats and produces profound hypothermia and causes excitement on induction (Wixson et al., 1987a,c,d). The young, the females, cooled animals, and possibly the albinos are more susceptible to the drug, whereas males, animals receiving low caloric diets, and animals on cedar bedding are more resistant." (7) Pg 109. The same book also states pentobarbital is not recommend for rabbits.

Heat Treated Shavings

Heat treated pine shavings are fine for use as bedding and litter for small animals including rabbits. The first piece of evidence is the fact that many people have been using pine shavings for years without any ill effect to their rabbit(s). The next pieces are what the veterinary books and others have to say about the use of shavings for litter. Harkness and Wagner Pg 61: "Bedding, which may be paper, sawdust, or soft pine, aspen, or cedar shavings should be nonallergenic, dust free, inedible, absorbent, nontoxic, and free of pathogenic organisms. Soft pine and cedar wood shavings are used for pet rodent bedding because of their pleasant aroma. However, because volatile hydrocarbons from these shavings may stimulate microsomal enzymes, they are avoided as bedding material for research animals. Softwood shavings and tissue paper make excellent rodent nesting material" (7) TBLR Pg 29 "Bedding must be used in nest boxes. It may be straw, hay, excelsior, wood shavings, or other such material." (8). Hillyer and Quesenberry pg 292 small rodent section: "Pine shavings remain the most commonly used bedding for small pet rodents in many parts of North America. Corncob products and recycled paper products are excellent for certain rodents such as gerbils and dwarf hamsters. Cedar shavings also are popular but their use is controversial. Cedar has been shown to affect microsomal oxidative liver enzymes. Although these changes affect factors such as drug metabolism, no clinical signs associated with them have been documented." (10) Rabbit Production Pg 90

"The nest box should ...contain bedding of hay, straw, shavings, or similar material." Pg 93 "If the does are being fed a ration consisting only of pellets, they may eat any palatable material used for bedding, and in this case softwood shavings...may be used" (9) If the use of softwood bedding was dangerous why on earth would any of these books mention it as good bedding material. All of these books are recent publications and the studies many cite showing a "danger" were published closer to 30 years ago.

Finally we have evidence treated pine is safe from the scientific studies pet owners often quote from (1,3,4,19). The process of heat treating removes the HME inducing agent as demonstrated in the above mentioned studies. It is also mentioned in the National Institute of Health guide to Laboratory animals "Heat treatments applied before bedding materials are used to reduce the concentration of aromatic hydrocarbons" (6). "By two different experimental approaches Wade et al. (47) showed that cedrol and cedrene were active agents in the inductive response of mice to cedarwood bedding. In the first experiment cedar shavings from which cedrol and cedrene had been extracted...produced hexobarbital sleeping times indistinguishable from those observed in control mice housed on inert corncob bedding." (4). I also offer this quote from an HRS educator I wrote to "There are some shavings which are safe, and these are the kiln-dried pine."

I have also heard the rumor cedar causes cancer. I found three studies (11,12,13) and none of them came to the conclusion cedar bedding caused or contributed to the occurrence of cancer. "From these results, the high incidence of cancer in the C3H-AvyfB strain could not be attributed to the routine use of cedar shavings in the bedding material." (11). "Hepatoma incidence in males at 18 months of age was not affected by the presence or absence of cedar shavings in the bedding " (12). "There was no evidence that the cedar shavings were carcinogenic." (13).

Sorting Through Rumors

The arguments presented by those against softwood bedding often sound convincing on the surface, however closer inspection reveals discrepancies. For example the HRS has made statements that softwood bedding has caused liver disease in rabbits they have fostered and caused the death of rabbits during surgery. I have read the article by HRS founder Marinell Harriman, "Litterboxes and Liver Disease" and question her conclusions. Apparently HRS began investigating softwood bedding after one rabbit died during a routine spay surgery. They maintain that rabbits housed on pine or cedar may risk death during surgery, however they also have made statements that they have not lost many rabbits during spays or neuters.

They stopped using softwood bedding after Sarah the rabbit died in 1989 so prior to her death they must not have had problems with surgery on other rabbits exposed to softwood. The article also discussed several foster rabbits had elevated liver enzymes and some had liver disease. Dr Hawley points out that the enzymes tested by veterinarians in a serum or plasma chemistry panel are "leakage enzymes" and not the same enzymes the researchers studied in the softwood bedding experiments (20).

So what could explain the liver disease in the HRS foster rabbits? I checked into liver disease in rabbits, there is very little about it but what I did find is hepatic coccidiosis, which causes an enlarged liver and it is contagious (7,8,9). I would assume the HRS members had adopted the rabbits that had liver disease so it is possible that the rabbits were exposed to hepatic coccidiosis, I feel it is a pretty big leap to assume untreated shavings caused their deaths. From TBLR: Pg 206 long section on hepatic coccidiosis, clinical signs included enlarged liver. pg

267: Liver cancer: "The tumor appears to have little potential as a research model, primarily because of the difficulty of case findings." (8). The common causes of liver spots in rabbits are hepatic coccidiosis, migrating tapeworm larvae, Tyzzer's disease, and colibacillosis (7). So there doesn't seem to be any evidence linking untreated softwoods to liver disease or other problems in rabbits.

Another opponent of softwood bedding is Debbie "The Rat Lady" Ducommun who wrote a long article pointing out the "dangers" of softwood bedding. She stated "Because of the toxic effects of softwood shavings, laboratories have pretty much stopped using them for their animals." Well as we now know this is not the reason some labs would not use them. Also where is the evidence that their effect is toxic? The liver disease connection was also brought up and she stated "unless these animals [rabbits housed on softwood] received full autopsies at death with no sign of enlarged livers or liver dysfunction, respiratory infection, or altered immune system, how can they claim that the pine or cedar did not affect them?" I submit that even with a full autopsy how can you tell softwood did, after all the animal died of something so we would expect to see problems. An enlarged liver is a sign of hepatic coccidiosis (8) so that can't be used as proof. And we know there are other causes of respiratory infection and other things that can alter the immune system. Also obesity can cause elevated liver enzymes and contribute to problems. An autopsy showing the above problems would not be proof that softwood bedding or HME induction caused liver damage.

I think there has been too much "interpreting" of scientific studies and that is what is causing the great pine/cedar scare. As an example let's look at chloroform. If you have municipal water then you and your animals are being exposed to chloroform. Is this harmful? What do the studies say, "Present in the water supplies of many of our cities in concentrations reaching 311ug/1, according to the Environmental Protection Agency, chloroform has also been identified as a contaminant of the air. Thus chloroform can gain entry and accumulate in organisms by both the oral and inhalational routes. From the point of view of this symposium, the question of the effects on laboratory animals of environmental exposure to chloroform is raised. Chloroform is toxic to both the liver and kidney of laboratory animals (12), liver tumors arising after chronic chloroform administration (13)." (4).

It looks like it is, and if you have been giving your animals municipal water you are killing them! Make sure you get a full autopsy done after they die and check for liver and kidney damage as well as respiratory problems to "prove" the chloroform was the cause. Oh wait a minute the study says a little more, "Chloroform is only one of a large number of newly identified environmental pollutants to which laboratory animals are being continuously exposed: continuous exposure of laboratory animals to chloroform, as well as to many other environmental pollutants, could affect the responsiveness of these animals under a wide range of experimental conditions." (4). Well I guess the scientists weren't warning us of the dangers of using municipal water after all, just discussing how it could affect experimental data.

We and our animals are exposed continually to different "pollutants" in our environment, what matters is the health of an individual and the concentration of pollutants they are exposed to. Some chemicals in small concentrations are harmless but in larger doses are lethal. An example of this is benzoic acid in Listerine. Benzoic acid is toxic if ingested in large enough quantities, the amount in Listerine is well below that amount and therefore is safe for use in humans. It is important not to over-interpret what scientific studies are showing us.

In closing I just want to say I still have not read, experienced, or heard anything that leads me to believe the use of pine shavings are harmful to rabbits. What I have read and experienced shows me they are safe. I included many quotes in this article so you are able to read exactly what the scientists have discovered about softwood bedding and the effects on HME. If one closely looks at the evidence offered that pine shavings are harmful you will see the arguments are weak and lack evidence. Dr Hawley reports pet retailers are

being subjected to anger from animal rights advocates who accuse them of selling "dangerous" bedding material (20). It's too bad these people didn't first read the studies instead of subscribing to the "I heard it was bad, so it must be true" theory. But those of you reading this now know more than you ever wanted to about softwood shavings and HME!

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- (7) Harkness & Wagner Biology and Medicine of Rabbits and Rodents 4th ed 1995. Note Harkness was featured speaker at HRS vet conference so he is rabbit knowledgeable.
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