

# Effects of Humic Acid on Animals and Humans

## Literature Review and Current Research

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#### Introduction

Humates are an accessible raw material that can be used in agriculture and animal husbandry in the form of a humate drink or dry feed as a source of mineral and organic substances for growth stimulation. Humates have long been used as folk remedies for a wide variety of illnesses <sup>(46)</sup>. Only in recent years has serious research investigated this natural material from the soil. These humates are a part of soil humus and play an important role in the living organism. Modern farming practices have stripped the soil of its humus and no replacements have been used. The humic substances have not been appreciated and as a result not addressed in fertilizing practices. Today, our soils are low on these humic substances and as a result animals and man are not receiving adequate amounts in our normal diet. Research has indicated that when soil humus percentages fall below 2%, the soil cannot provide sufficient quantities of humic materials into the crops grown for the amounts needed by the living organism. This paper reviews those roles that the humic materials play in our lives.

#### Safety

Humate is a safe material and exists in all soils, plants and animals. It is natural to the food chain and plays a role in the composting of dead matter into nutrients, transfer of minerals and other roles within the living organism. Many technical papers attest to humate's safety. Scientist at the Drepropetrovish Agricultural Institute in Moscow revealed humate harmless with respect to blood, cardio-vascular system, endocrine system and other vitally important organs using patho-histological and histochemical methods. Humate does not cause allergic reactions, anaphylaxis (unexpected reactions) to other medicines; it is an apyrogen. Humate does not have embryo-toxic properties. The toxicity of naturally occurring humic acid is remarkably low <sup>(11)</sup>. The level of toxicity on an LD-50 test of 0.536 grams per kilogram can be considered as a conformation of the harmlessness of humate <sup>(15)</sup>. Current repeat toxicity studies presented by Laub Biochem indicated total safety at levels up to 50 mg/kg of body weight <sup>(28)</sup>. Introduction of humates into the feed ration of chickens has reduced unspecific deaths 3 to 5% <sup>(14)</sup>. Humates being fed to dairy cattle have shown no change in milk chemistry <sup>(26)</sup>. Broadly speaking, concentrations in the range of 50-2000 part per million (ppm) are usually effective, yet are not cytotoxic <sup>(11)</sup>.

## Definitions

### Humate

Technically this term describes the salts of humic acid. Generically it is the term given to all humic substances.

### Humic Acid

Humic Acid is a long chain molecule, which is high in molecular weight, dark brown and is soluble in an alkali solution. This is the portion of the soil responsible for composting and transfers the nutrient from the soil to the living organism. This material accompanies the nutrient into the organism and performs many benefits.

### Fulvic Acid

Fulvic Acid is a short chain molecule, which has a low molecular weight, yellow in color and soluble in both acid and alkali. This is the portion of the soil responsible for chelating (grabbing hold of metals) minerals and transferring them to the living organism. Fulvic acid is unique in its chelation ability as it captures life essential minerals and places an electrical charge on them for ready uptake by the organism. Toxic metals are also chelated, but are neutrally charged and have difficulty in entering a living organism. Fulvic acids also act to detoxify the body of those heavy metals that may enter it.

### Ulmic Acid

Ulmic acid is that portion of the soil that is soluble in alcohol. It is a dark material semi-solid material. It is little understood and has little research history.

### Humin

Humin is that portion of the soil that is non-soluble. It is a dark brown material, extremely high molecular weight and is responsible for the soils water holding capability, crumble and electrostatic conductivity.

### Humic Substance

The portion of the soil created by decaying organic matter.

Humates exist in many locations around the world, but vary in composition much the same way as crude oils. They are hydrocarbons and contain aromatic and heterocyclic structures, carboxyl groups, and nitrogen. They contain fragments of DNA, RNA and possess many active hydrogen bonding sites making them very chemically reactive.

## Nutrition Value

Nutritional analyses <sup>(27)</sup> vary with the differing humates. Those humates used in the case studies at the end of this paper contained 42 to 48% humic acid of which 12% of the humic acid was in the fulvic acid range.

	% by Wt.
Protein	7.10
Ash	8.33
Fibre	12.50
Carbohydrates	51.20
Nitrogen	1.14
Moisture	17.66
Ammonia	1.38
Trace Minerals (See Below)	<u>0.69</u>
Total	100.00%

**Trace Minerals (ppm)**  
**In Chelated Form**

Aluminum 10	Chlorine 8.0	Hafnium 0.9	Molybdenum 0.9	Rubidium 4.0	Terbium 1.0
Antimony 0.3	Chromium 0.3	Holmium 0.5	Neodymium 10	Ruthenium 0.5	Thallium 5.0
Arsenic 0.8	Cobalt 0.9	Indium 0.5	Nickel 2.0	Samarium 0.9	Thorium 5.0
Barium 0.5	Copper 4.0	Iodine 0.1	Niobium 1.0	Scandium 0.9	Thulium 0.5
Beryllium 0.1	Dysprosium 0.9	Iridium 0.9	Osmium 1.0	Selenium 1.0	Tin 0.3
Bismuth 0.5	Erbium 0.8	Iron 1000	Palladium 0.5	Silicon 60	Titanium 0.1
Boron 0.8	Europium 0.9	Lanthanum 1.0	Phosphorus 30	Silver 0.2	Tungsten 5.0
Bromine 0.2	Fluorine 5.0	Lead 0.6	Platinum 0.5	Sodium 300	Vanadium 0.5
Cadmium 4.2	Gadolinium 0.5	Lithium 16	Potassium 1000	Strontium 4.0	Ytterbium 0.1
Calcium 300	Gallium 1.0	Lutetium 0.1	Praseodymium 10	Sulfur 2000	Yttrium 0.1
Cerium 4.2	Germanium 0.5	Manganese 34	Rhenium 0.5	Tantalum 0.6	Zinc 8.0
Cesium 4.2	Gold 0.1	Magnesium 2000	Rhodium 0.5	Tellurium 5.0	Zirconium 1.0

Adding humate to the fodder of broiler chickens increases the yield mass on average of 5 to 7% <sup>(14) (13)</sup>.

Dairy cattle being fed humates showed improved feed efficiencies. The control herd ate an average of 38 lbs. of feed daily while the test herd consumed 36 lbs. daily. Milk production for the test herd increased 1.9 lbs. per day per animal. Since milk production is a direct function of feed intake, the animal feed efficiency increased <sup>(26)</sup>.

Observational reports from farmers using the humate in their feeding programs have reported additional weight gains and healthy livestock on beef cattle, hogs, chickens, emus and earthworms.

**Health Value**  
**Blood Properties**

It has been found that humic acid in dose levels of 100-300 milligrams per kilogram body weight has no effect on bleeding time, clotting time, thrombin time, plate count, or induced platelet aggregation <sup>(49)</sup>. Red blood cells and hemoglobin stay on normal levels under the influence of humate in comparison with control groups <sup>(15)</sup>. Literature has indicated that the red blood cells have the capability of carrying higher percentages of oxygen when in the presence of humate. Human subjects taking humate have reported feelings of euphoria, similar to hyperventilating, during the first few days of taking humate. This euphoria is a result of additional oxygen. Healing of injuries, as a result of additional oxygen, is much quicker. Cutting horses have ankle inflammations frequently from their rigorous training programs. Healing times for these injuries have been reduced by the usage of humates.

**Mineral Transfer**

Humates contain both humic and fulvic acids. The fulvic acid is the chelator that carries the minerals. The humic acid acts as dilator increasing the cell wall permeability. This increased permeability allows easier transfer of minerals from the blood to the bone and cells. Testing on cows has indicated an increase of 16% more calcium <sup>(48)</sup>. It has been shown that incubation of cultured human umbilical vein endothelial cells with natural or

synthetic humic acid results in an enhanced surface expression of tissue factor activity. There are also changes in intracellular divalent calcium levels <sup>(1)</sup>. Literature reports additional transport of iodine from foods into the thyroid glands <sup>(2)</sup>.

Just as fulvic acid carries life-sustaining minerals to the body, it also captures and removes toxic metals from the body. Detoxification takes place within first three to four days of usage. Both human and animal have reported looseness of bowels due to detoxification during this period and return to more solid manure after the third to fourth day.

### **Stress Management**

Literature has reported that humates block or reduce the production of stress causing hormones. This has been observed in animal behavior, in particular with show calves first entering the arena. Animals on humate are less affected by the outside stimulus of the crowds or confining areas of the arena. This effect has been noted on sheep, horses, cattle and hogs. In dairy operations, those animals not on humate aggressively eat their feed rations while humate animals leisurely graze.

Laboratory testing at Penn State physically restrained rats by binding them to artificially create stress and measured hormones known to cause stress. Those rats fed humate showed significantly less amounts of those hormones.

### **Cell Mutation**

Humates within the body work with DNA and cellular division. It has been noted that the humate tends to prevent cellular mutation during reproduction. Several technical papers were noted during literature research for this paper regarding cancer research with humates.

Natural humic acid administered prophylactically to rats can decrease significantly the amount of gastric mucus damage induced with ethanol. Humic acid also significantly accelerated the healing process of experimentally induced ulcers <sup>(52)</sup>.

### **Microbial Interaction**

Humates are known to stimulate microbial activity. In soil testing for microbial activity, levels increased 400 to 5000 times with the introduction of humate (300 ppm) into the soil. Humates added to feed rations stimulate the microbial growth and the extent can be quite large depending upon the species, the culture medium, and the environment <sup>(45)</sup>.

Humic substances have been also known to exhibit anti-microbial properties. Species for which natural humic substances have been shown to be inhibitory include *C. albican*, *Ent. Cloacac*, *Prot. Vulgaris*, *Ps. Aeruginosa*, *S. typhimurium*, *St. aureus*, *St. epidermidis*, and *Str pyogenes* <sup>(12)</sup>. It seems that within the body, humates stimulate the “good” microbes while suppressing the “bad” microbes. Testing of milk during field trials indicated a large increase of microbes within the milk. This is usually an indication to the dairyman of impending mastitis (teat infection). The opposite actually happened. Mastitis cases within the milking herd dropped from an average of 3 to 4 cases daily to 4 cases in a month <sup>(26)</sup>. Additional confirmation of reduction of mastitis was observed in lactating female goats. Three female goats with severe mastitis were administered doses

of humate over a two-week period. At the end of 7 days, swelling of the mammary glands had subsided and the goats were back to normal activity allowing the kids to nurse without discomfort.

### **Immune System**

Humates booster the immune system. Dr. Daryl See, MD, Immunologist of UCLA Medical School suggests that the mechanism is related to the humates ability to complex sugars within the body. The abundance of these complex sugars allows the body to manufacture glycoproteins that attach to the killer and T cell acting as a modulator or communication link between the cells. This regulates the immune system cells and prevents either the T or Killer cells from becoming out of balance. Excessive killer cells can attack bone and joints causing arthritis. Conversely, excessive T cells can cause auto-immune diseases.

Along this same line, burn victims and radiation sickness experience immune system responses that attack the bodies dead cells creating unwanted infections. Humates cause the immune system to recognize its own dead cells thereby reducing infection. Baylor Medical School is currently researching humates both topically applied and internally dosed for burn victims to reduce infections. Russian scientists are using the same principle for the treatment of radiation sickness. Sodium humate has been found to increase the lifespan of mongrel rats exposed to lethal doses of cobalt radiation <sup>(8)</sup>.

### **Anti-inflammatory Properties**

Humic acids isolated from peat exhibited significant efficacy for adhesions when tested on female rats that had standardized lesions placed on both uterine horns and the peritoneum of the anterior abdominal wall <sup>(1)</sup>. Humic substances, including peat and sodium humates, are known to exhibit anti-inflammatory properties <sup>(47)</sup>. Inflammatory states of the cervix, especially cervical erosion (generally known as cervicitis) can be treated with humic preparations <sup>(41)</sup>.

Not only does the humate relieve swelling from joint inflammation, it has been shown to bond to the collagen fibers to aid in repair of damaged tendons and bone. Tendon strength has been shown to increase by as much as 75% <sup>(9)(48)</sup>.

### **Anti-Viral Properties**

Humates are effective media additives for the production of antibiotics in the soil <sup>(45)</sup>. Humic substances have long been known to exhibit antiviral properties <sup>(44)</sup> in particular rhinoviruses <sup>(35)</sup>. Viral pathogens for which soil-extract materials have been shown to be effective include in particular Coxsackie virus A9 <sup>(34)</sup>, herpes simplex virus type 1 and 2 <sup>(10),(11), (21), (29), (36), and (37)</sup>, human immunodeficiency virus (HIV) <sup>(22), (30), (31), (38), and (39)</sup>, influenza type A and B <sup>(22), (35), (38), and (40)</sup>, as well as other respiratory tract infections. <sup>(33), (34), (35), (37), and (41)</sup>.

The mechanism whereby humic substances inhibit the cytopathicity of a number of viruses has been studied in some depth. It is thought that the materials prevent viral

replicating by sorbing onto the viral envelope protein and thereby blocking the sorption of viral particles to cell surfaces <sup>(31)</sup>.

Humic acids have also been employed as veterinary medicine therapy successfully employing peat mull (extracted humic acid) to prevent the transmission of foot and mouth disease in pigs <sup>(33)</sup>. Humate is a pharmacy that raises non-specific organism resistance. This fact was confirmed by using such models as atoxic anemia, toxic hepatitis, peptic ulcer and hypercholesterolemia <sup>(15)</sup>.

### **Liver Effects**

The effect of natural humic acid on the regenerative response of liver tissue has been examined in rats submitted to two-thirds hepatectomy. Long term application of humic acid resulted in the stimulation of ornithine decarboxylase, an increase in spermidine and histamine as well as DNA and RNA levels, and in overall liver mass <sup>(50)</sup>. Humic as well as fulvic acids extracted from peat have been shown to stimulate respiration in rat liver mitochondria when present at concentrations of 40-360 micrograms per ml. Humic substances at concentrations of 40-400 micrograms per ml. also increased the efficiency of oxidative phosphorylation in mitochondria in vitro, particularly after contact periods of over 1 hour <sup>(51)</sup>.

A large part of the humate takes an active part in the liver metabolism. The use of humate plays a role in the liver function and protects it somewhat from disease and/or disturbances <sup>(15)</sup>.

### **Detoxifying Properties**

Fulvic acid, a component of humate, is a strong chelator. It is unique in its chelating ability. Life sustaining minerals, when chelated by fulvic, are placed in a chemical state (phyto-state) such that they are readily absorbed by the cell or organism. Toxic heavy metals are also chelated but placed in a chemical state that is difficult for cellular absorption. Fulvic acid in the soil acts as a filter for toxic metals. It will grab the a toxic metal and immobilize it which prevents it from migrating or chemically reacting. When crops are grown on soils deficient in fulvic acid, toxic metals can be absorbed by the plant and passed into the food chain. Many of our foods present today are grown under conditions of "worn out" soil. As a result, more toxic metals are being ingested. Fulvic acid has the capability of removing these toxic metals from the body.

### **Odor Reduction**

Texas A&M University System researchers have discovered that using humate decreases volatile ammonia in animal waste by 64%, reduces odor, and improves the nitrogen to phosphorus ration in the waste. Scientist are developing ration formulations to enhance manure characteristics while maintaining animal performance as well as devising other approached to maintain feedlot efficiency and manage waste <sup>(25)</sup>.

Observations from field trials on dairy animals indicate a more complete digestion of feed as observed from the manure and urine. Manure from the humate test herd consisted of fine particle, low odor matter while control animals contained lumps of corn and straw

and high ammonia odors. Urine from the test herd was clear and odorless while the control herd was amber with odor<sup>(25)</sup>. A similar effect has been observed on hogs.

Hydrogen Sulfide (H<sub>2</sub>S) (rotten egg odor) has also been reduced by the addition of humate to the mix. Wagner Quarries Company has demonstrated reductions in H<sub>2</sub>S by humate interaction. The mechanism is not fully understood, but results indicate good odor reduction<sup>(23)</sup>.

### **Miscellaneous Properties**

Chemically (strophantinum) induced heart stoppage in frogs was examined. Frogs that were given humate continuously for 10 days prior to the drug increased the time of heart activity 48.7% in comparison with the control group. Additionally the protective property of the humate was revealed when toxic doses of strychnine (inhibits metabolism in the central nervous system) were administered to test mice. Those mice (70%) given humate 10 days prior to the treatment lived while 100% of the control died<sup>(15)</sup>.

### **Case Histories**

#### **Beef Cattle**

Texas A&M under the leadership of Dr. Chirase performed humate feeding trials on steers at a feedlot in the Amarillo area. Reported results of the 56-day study indicated a 12% increase in feed efficiency. Manure samples were of a fine texture with reduced odor. Blood data indicated increases in hemoglobin and antioxidants<sup>(53)</sup>. Follow up testing on the odor indicated a 64% reduction in ammonia from the animal waste when humate was mixed into it<sup>(24)</sup>.

A farmer in Waco, Texas, mixed humates into the rations of a mature cow and three calves. Reports after 60 days indicated coloration and health of the animals to be excellent. Weight gain on the calves was reported to be above the norm. Although no usable data was collected on this test, the cattleman did report something that was significant. He had been trying to breed the cow over a three-year period without success. During the testing period, the cow became pregnant.

#### **Dairy Test**

Canton, Texas. This test was run on 500 high producing dairy cattle over a 28-day period. Milk, blood and animal waste were analyzed before, during and after the testing period. The introduction of the humate into the diet produced 1.9 pounds of extra milk daily per animal. The feed consumption dropped from 38 lbs. per day to 36 lbs. per day during the test. At the conclusion of the test period, consumption returned to 38 lbs. With these changes in feed quantities, it can be concluded that the animal was digesting its nutrient more completely, thus creating greater milk production. Additionally the humates produced a calming effect on the animals as exhibited by lowered aggressiveness in eating and reduced the effects of heat stresses produced by summer temperatures. Lactation decline curves flattened significantly during the testing period. This indicates that longer milking periods can be achieved raising the cumulative amounts of milk received from each cow. Odors from the animal wastes were reduced.

Less volumes of manure and reductions in ammonia odor results in less waste and reduces the effects of potential insect born diseases <sup>(26)</sup>.

### Goats

Sunset, Texas. Nursing female goats were experiencing mastitis (teat infection) and would not allow the kids to nurse. Humate was introduced into the ration and within one week all infection had cleared up.

Brady, Texas. Angora goats are being fed humate to improve the quality of the wool. Reports from the wool buyers indicate that the humate fed goats have longer staple and more lanoline in the wool. Pricing on angora wool is based on quality.

### Hogs

Dr. Matt Colvin, DMV reports that he is using humates in the diet to treat scours in piglets. His experience with the humates indicates that it is a very effective treatment. Additionally, he is reporting additional weight gain with meat that is lean with good textured and excellent taste. Reproduction from the humate fed sows is excellent and produces larger than normal piglets.

### Rattan (Ostrich, Emus)

Clayton, New Mexico. A farmer raising ostrich has reported plumage development on young birds has been accelerated. Eggshell development is excellent and uniform. The yokes are reported to be firmer. A greater percentage of hatchings are being produced. The farmer also reported that hoof rotation has ceased to be a problem. Hoof rotation is a problem on long legged animals. It results when tendon and muscle grow faster than bone in young animal and results in a clubfoot. Prior to the humate, the farmer was experiencing about 5% of his young birds experiencing some degree of hoof rotation. Since the introduction of humate, bone growth has kept up with muscle grown and reduced hoof rotation problems to below 0.5%.

Waco, Texas. The farmer was raising emus. Since the market price on emus had fallen, he was allowing the flock to forage and supplementing with millet (a low cost feed). At the time the humates were introduced into the diet, the birds were in poor to fair shape. Hot summer temperatures had taken their toll on the birds and plumage and skin were in poor condition. Humate was fed over a 60-day period. The health of the birds greatly improved and plumage became excellent with bright coloring. Under hot dry conditions the females do not start the reproduction cycle until late fall when the summer heat breaks. The females in this flock started the reproduction cycle in mid September (still hot). The only way this can happen is for the bird to be in excellent health.

## Chickens

Purcell, Oklahoma. Two pens (20 each) of newly hatched chicks were used for a test and control. The test birds were fed humate in the diet while the control was not. Feather development came earlier on the humate birds. The test group was fully feathered a full week ahead of the control group. Weight gain of the test group after 30 days amounted to 1.5 pound more mass than the control group. Of notice was the calming factor of the humate. One could enter the test pen and the birds continued with their normal pecking and wanderings while those in the control pen would become extremely excited and run with wildness. The test was continued onward for a period of six months. The mature birds were monitored for egg production. Eggs shells from the humate group were thicker and more uniform in size. Hatchling chicks from the test group were larger and more active.

## Horses

Excerpt of letter from cutting horse owner in Boyd, Texas. "I started using humate in my horses 6 years ago. I have found that even in the winter when the animal's hair is long and coarse, that my horses have a deep, rich, shining coat and bright eyes. They are very alert but not hyper. I haven't had a sick horse in years and their hooves grow well and hold a shoe extremely well. My horses overall health and performance, since I have been feeding the humate is excellent."

Willow Springs, Texas. Willow Springs is the site of a large training area for racing and cutting horses for the Dallas Fort Worth metroplex. The training regimen for these animals is quite intense. Front ankle injuries with swelling are quite common and require several weeks of inactivity to heal properly. This inactivity extends the expensive training time. Several of the trainers tested the humates in their animals. They found that healing times for the ankle injuries were reduced by one to two weeks. In timing trials, the humate horses were performing better. It is not uncommon for a quarter horse on humate to be able to shed a few tenths of the second on his time. In quarter horse racing those few tenths can mean the difference between winning and losing.

Fort Worth, Texas. This horse was a successful registered western pleasure paint that suddenly came up with severe degenerating hooves. The attending farrier hadn't seen such a severe case in years. On all four hooves, there was insufficient nail to place a shoe. Humate was introduced into the ration. Hoof grow out was immediately outstanding. Shoes were able to be put on in about 4 to 5 months and the horse was back in the show ring. The farrier was shocked at the improvement.

## Human

Excerpt from letter. Male, aged 63, Boyd, Texas. "I feel I need to respond about the wonderful qualities I have found in my six plus years use of your natural humate product. I found my skin and complexion to improve; the graying in my hair changed to

the deeper richer color of my original hair color and my all around health has improved greatly. I haven't been to the doctor in years, no colds, allergies, etc.”

Male, aged 72, Fort Worth, Texas. This individual has been taking the humate for a period of 7 years. Before and during the period he has been taking the humate, he has taken a yearly physical under the same doctor. These physicals require two to three days in the hospital for testing, poking and probing. The doctor was notified of the humate and has watched for signs of body change from the 30 years of history accumulated on this individual. Yearly medical reports from the doctor indicate the overall health of the individual has improved. Blood oxygen has increased and fatty cholesterol levels have lowered without changes in diet. Heart functions have improved on a yearly basis. The doctor has noted no ill effects from the humate and has advised the individual to remain on his current regimen of humate. During the seven years, the individual has only experienced one case of sinusitis and no cases of flu or colds.

Female, aged 38. Raton, New Mexico. This individual has had a history of anemia. After 60 days on humate, the anemia conditions went away. That was five years ago and the condition has not returned. Her doctor has confirmed these facts and now recommends humate for his patients with anemia problems.

Female, aged 13. Cincinnati, Ohio. This young female was experiencing anemia. She had received the humate from a friend and began taking it without her parent's knowledge. Her father is a medical doctor and learned of her activities during a physical examination. The anemia was not present and he questioned her to see what lifestyle changes she may have made. The doctor, after researching, now commonly prescribes humate to help build up his patients health.

## Bibliography

1. *Effects of humic acid on the viability and coagulant properties of human umbilical vein endothelial cells.* Yang, H.L.; Chiu, H. C.; Lu, F. *Am J. Hematol*, 1996; Vol. 51, Issue 3, Pages 200-206.
2. *Effect of humic acid on the availability of iodine in the food, investigated with the histometric assessment of the thyroid gland.* Seffner, W. Conference Paper Mengen- und spurenelemente – 15 Arbeitstagung, December 1995, Jena, Germany. *Mengen Und Spurenelemente* Pages 465-472.
3. *In-vivo and In-vitro mutagenicity studies on natural humic acid (HA).* Bernacchi, F.; Ponzanelli, I.; Barale, R.; Bertelli, F. Conference Paper 37 Riunione scientifica, October 1991, Alghero, Italy. *ATTI-Associazione Genetica Italiana*, 1991, Vol. 37, Pages 49-50.
4. *The use of a processed humic acid product as a feed supplement in dairy production in the Netherlands.* Thomassen, B. P. H.; Faust, R. H. Conference Paper IFOAM; IFOAM 2000, the world grows organic international scientific conference, August 2000, Basle. Page 339
5. *Induction of oxidative stress by humic acid through increasing intracellular iron; a possible mechanism leading to atherothrombotic vascular disorder in blackfoot disease.* Gau, R. J.; Yang, H. L.; Suen, J. L.; Lu, F. J. *Biochem Biophys Res Commun*, 2001; Vol 283; Issue 4; Pages 743-749.
6. *Humic acid induced growth retardation in a sertoli cell line, TM4.* Chen, Y. J.; Lin-Chao, S.; Huang, T. S.; Yan, M. L.; Lu, F. J. *Life Sci*, 2001; Vol. 69; Issue 11; Pages 1269-1284.
7. *Effect of phenol ring polymers on the release of plasminogen activators.* Klocking, H. P.; Klocking, R.; Helbig, B. *Farmakol Toksikol*, 1984; Vol. 47; Issue 1; Pages 93-95.
8. *Effect of sodium humate on animals irradiated with lethal doses.* Pukhova, G. G.; Druzhina, H. A.; Stepchenko, L. M.; Chebotarev, E. E. *Radiobiologiya*, 1987; Vol. 27; Issue 5; Pages 650-653.
9. *Sodium humate in the treatment of osteoarthritis patients.* Iubitskaia, N. S.; Ivanov, E. M. *Vopr Kurortol Fizioter Lech Fiz Kult*, 1999; Issue 5; Pages 22-24.
10. *Results of an oriented clinical trial of ammonium humate for the local treatment of herpesvirus hominis (HVH) infections.* Schiller, F.; Klocking, R.; Wutzler, P.; Farber, I. *Dermatol Monatsschr*, 1979; Vol. 165; Issue 7; Pages 505-509.
11. *Comparison of the in vitro activities of ammonium humate and of enzymically oxidized chlorogenic and caffeic acids against type 1 and type 2 human herpes virus.* Thiel, K. D.; Heibig, B.; Klocking, R.; Vutzler, P.; Sprossig, M.; Schweizer, H. *Pharmazie*, 1981; Vol. 36; Issue 1; Pages 50-53.

12. *Humate induced activation of human granulocytes.* Riede, U. N.; Zeck-Kapp, G.; Freudenberg, N.; Keller, H. U.; Seubert, B. **Virchows Arch B Cell Pathol Incl Mol Pathol**, 1991; Vol. 60; Issue 1; Pages 27-34.
13. *The content of free amino acids in the tissues of broiler chicks administered sodium humate in the ration.* Zhorina, L. V.; Stepchenko, L. M. **Nauchnye Doki Vyss Shkoly Biol Nauki**, 1991; Issue 10; Pages 147-150.
14. *The effect of sodium humate on metabolism and resistance in highly productive poultry.* Stepchenko, L. M.; Zhorina, L. V.; Kravtsova, L. V. **Nauchnye Doki Vyss Shkoly Biol Mauki**, 1991; Issue 10; Pages 90-95.
15. *Experimental bases and prospects for the use of humic acid preparations from peat in medicine and agricultural production.* Lotosh, T. D. **nauchnye Doki Vyss Shkoly Biol Nauki**, 1991; Issue 10; Pages 99-103.
16. *The effect of sodium humate on cadmium deposition in the organs of chickens.* Herzig, I.; Hampi, J.; Docekalova, H.; Pisarikova, B.; Vicek, J. **Vet Med**, 1994; Vol. 39; Issue 4; Pages 175-185.
17. *Pharmacokinetics of sodium humate in chickens.* Hampi, J.; Herzig, I.; Vicek, J. **Vet Med**, 1994; Vol 39; Issue 6; Pages 305-313.
18. *Inhibition of HIV-1 in cell culture by synthetic humate analogues derived from hydroquinone; mechanism of inhibition.* Schneider, J.; Weis, R.; Manner, C.; Kary, B.; Werner, A.; Seubert, B. J.; Reide, U. N. **Virology**, 1996; Vol. 218; Issue 2; Pages 389-395.
19. *Caecal metabolites and microbial populations in chickens consuming diets containing a mined humate compound.* Shermer, C. L.; Maciorowski, K. G.; Bailey, C. A.; Byers, F. M.; Ricke, S. C. **Journal of the science of food and agriculture**, 1998; Vol. 77; Issue 4, Pages 479-486.
20. *Use of ristocetin cofactor activity in the management of von Willebrand disease.* Ewenstein, B. M. **Haemophilia**, 2001; Vol 7; Suppl. 1; Pages 10-15.
21. *In vitro studies of the antiviral activity of ammonium humate against herpes simplex virus type 1 and type 2.* Thiel, K. D.; Klocking, R.; Schweizer, H.; Sprossig, M. **Zentralbl Bakteriol**, 1977; Vol. 239; Issue 3; Pages 304-321.
22. *Laub developing humate with anti-HIV, HSV, HPV and other antiviral activity.* Laub, R. **Biotechnology Information Institute**, February 2000. Antiviral Drug and Vaccine Development Information, Vol. 12, No. 2. ISBN 0897-9871.
23. *H2S odor control system.* Wagner Quarries Company. Press Release, October 2000, Sandusky, Ohio. [www.wagnerquarries.com](http://www.wagnerquarries.com).
24. *Effect of chemical treatments, ration composition and feeding strategies on gaseous emissions and odor potential of cattle feedyards.* Parker, D.; Auvermann, B.; Greene, W. Pre-publication **Texas A&M Extension Service**, December 2001. TAMU Ag Research and Extension Ctr. Amarillo, Tx.
25. *Efficient waste and odor management for feedlots.* Greene, L. W.; Cole, A.-USDA/ARS. **The Agriculture Program**. Texas A&M University System, AGCOM 5-1-00. <http://agprogram.tamu.edu>; press release, May, 2000.
26. *Field trials of dairy cattle.* Mosley, R. Non-published research. Enviromate, Inc. August 1996.
27. *Humate lab data.* Bunch, G. **Southwestern Laboratories**, December 1981. Midland, Tx. File No. C-1950-X.
28. *Acute systemic toxicity studies of natural product and synthetic humates.* Laub, R. **Laub BioChem Corp.**, August 1998. [www.laubbiochem.com](http://www.laubbiochem.com).
29. *The chemically induced inhibition of HSV infection.* Laub, R. **Laub BioChem Corp.**, August 1998. [www.laubbiochem.com](http://www.laubbiochem.com).
30. *The chemically induced inhibition of HIV-1 replication.* Laub, R. **Laub BioChem Corp.**, January 1995. [www.laubbiochem.com](http://www.laubbiochem.com).
31. *Process for preparing synthetic soil-extract materials and medicament based thereon.* Laub, R. **U. S. Patent No. 5,945,446**, August 1999.
32. *Studies on the antimicrobial effect of natural and synthetic humic acids.* Ansorg R., et al., **A rxeimittelforschung**, 1978. Vol. 28, Issue 12, pages 2195-2198.
33. *Investigations on the viricidal effects of humic acids in peat.* Schultz, H. **Tierarztl Vochenschr**, July 1965, Vol. 72, Issue 13, pages 294-297.
34. *Antiviral properties of humic acids.* Klocking, R.; et al. **Experientia**, May 1972, Vol. 28, Issue 5, Pages 607-608.
35. *The effects of phenolic polymers on retroviruses.* Sydow, G.; et al. **Pharmazie**, December 1986. Vol. 41, Issue 12, Pages 865-868.
36. *Therapeutic effect of E-5-2-bromovinyl 2-deoxyuridine, caffeic acid oxidation product, and trisodiumphosphonofornate on cutaneous herpes simplex virus type 1 infected guinea pigs.* Helbig, B.; et al. **Med Viral**, 1987; Vol. 23; Issue 3; pages 303-309.
37. *Interaction of humic acids and humic acid like polymers with herpes simplex virus type 1.* Knocking, R. **Humic Substances in the Aquatic and Terrestrial Environment**, Berlin, 1991; pages 408-412.
38. *Selective inhibitory activity of polyhydroxycarboxylates derived from phenolic compounds against human immunodeficiency virus replication.* Schols, D.; et al. **Acquir Immune Defic Syndr**, 1991; Vol. 4; Issue 7, pages 677-685.
39. *Hexaprenoid hydroquinones. Novel inhibitors of the reverse transcriptase of human immunodeficiency virus type 1.* Loya, S.; et al. **Journal of Natural Products**, December, 1993; Vol. 52, Issue 12; pages 2120-2125.
40. *Effectiveness of phenol body polymers against influenza virus.* Mentel, R., et al. **Biochem Acta**, 1983; Vol. 42; Issue 10; pages 1353-1356.
41. *A randomized blind study on the efficacy of Tolpa Torf preparation in the treatment of recurring respiratory tract infections.* Jankowski, A.; et al. **Arch Immunol Ther Exp**, 1993; Vol. 41; Issue 1; pages 95-97.
42. *Synthesis and characterization of humic acid like polymers.* Hanainen, K. L.; et al. **The Science of the Total Environment**, 1987; Vol. 62; pages 201-210.
43. *Comparison of the effect of natural and synthetic humates and EDTA on the growth of escherichia coli.* Jakubiec, M.; et al. **Arzneimittelforschung**, 1978; Vol. 28; Issue 12; pages 2195-2198.
44. *The use of the HET-CAM test for the determination of the irritating effect of humic acids.* Wiegleb, K.; et al. **Dtsch Tierarztl Wochenschr**, October 1993; Vol. 100; Issue 10; pages 412-416.
45. *Effect of humates on microbial activity.* Huck, T. A.; Porter, N.; Bushell, M. E. **J. Gen. Microbiol.**, 1991; Vol. 137; Issue 10; pages 2321-2329.
46. *Rich soils for cures.* Achard, F. K. **Creels Chem. Ann.**, 1986; Vol. 11; pages 391-403.

47. *Humates and inflammation*. Kuhnert, M.; et al. **Arch. E-p. Veterinarmed.**, 1982; Vol. 36; pages 169-177.
48. *Effects of Implanted bovine calcium hydroxyapatite with humate*. Kreutz; Schlikekewey, W. **Arch. Orthop. Trauma Surg.**, 1992, Vol. 111; Issue 5; pages 259-264.
49. Malinowska, M. H.; Pietraszek, D; Chabielska, E. **Acta Pol. Pharm.**, 1993, Vol. 50; Issue 6; pages 507-511.
50. *An examination of humate stimulated liver functions*. Maslinski, C; Fogel, W. A.; Andrzejewski, W. **Acta Pol. Pharm.**, 1993; Vol. 50; Issue 4-5; pages 413-416.
51. Visser, S. A. **Sci. Total Environ.**; 1987; Vol. 62; Issue 4; pages 347-354.
52. Brzozowski, T; Dembrinski, A.; Konturek, S. **Acta Pol. Pharm.**, 1994; Vol. 51; Issue 1; pages 103-107.
53. *Effects of bovipro on performance and serum metabolite concentrations of beef steers*. Chirase, N. **Amer. Soc. of Animal Sci. Proceedings**; West Section No. 51, 2000.