Ascobic Acid Therapy

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For many years it has been common belief that ascorbic acid need not be considered in the feeding of domestic animals. The basis for this belief is the fact that domestic animals are capable of making this vitamin in their bodies. Because of this it was thought that there was no occasion for an avitaminosis of ascorbic acid.

Wallis, of the South Dakota Experiment Station (3), has shown that the old belief, that it is unnecessary to provide animals with food sources of ascorbic acid, must be revised. Studies of vitamin C concentration in plasma and of the metabolism of the vitamins showed that cattle were not independent of this factor in food sources.

Scurvy in Calves

Ascorbic acid deficiency has been definitely demonstrated in different animals. This deficiency may not be as pronounced as scurvy in man, but it is significant. Duncan, Huffman, Mitchell and Hess of Michigan State College (2) have reported an outbreak of scurvy which killed 35 cows and calves on one farm. The symptoms of this reported case of scurvy closely resembled the disease as seen in man, and blood assays showed that the cows were deficient in ascorbic acid.

First the liver, and then the muscles of the body were erroneously thought to synthesize ascorbic acid. In 1943, the Journal of Biochemistry reported that it had been proved that, "Vitamin C synthesis is a general metabolic function, not the function of any particular organ." Wallis (3) found that the elimination of ascorbic acid in cows greatly exceeded the intake of this factor in the feed after the animals had been on an ascorbic acid free diet for a long period of time. This finding indicated that ascorbic acid was synthetized by the cow.

Quantity in Feed

It appears that the quantity of ascorbic acid in the feed does not necessarily indicate whether the animal may, or may not, be suffering from an ascorbic acid deficiency. During severe metabolic disturbances accompanying various diseases, it is quite probable that the animal may suffer from a deficiency of ascorbic acid, either due to the decreased synthesis of this factor, or increased demand for it on the part of the body.

Lauber, Nafsiger, and Bersin (5) proved by actual experimentation that ascorbic acid deficiency is accompanied by a disturbance and retardation of callus formation in the healing of fractures. They also demonstrated that infections did not increase the body's demand for ascorbic acid, while fractures did. Lanman, Uzbekov, Ingalls, Tabbel, Harvey, Lauber, and Rosenfelf (8) have all presented evidence that the body ascorbic acid requirements are increased during wound healing. Uzbekov (6) has also suggested in his writings that, "Care should be taken in the diet concerning the content of vitamin C during the healing of burns." Tabbel and Harvey (7) have performed experiments to determine the relation of ascorbic acid to wound healing, using partially scorbutive animals, fully scorbutive animals, and non-scorbutive animals as controls.
Similar stomach wounds were made in all the animals. Every day, until healing had occurred, the stomachs were distended with air to test the relative strength of the healing wounds. It was found that the wound healing in the partially scorbutic animals was delayed more than that of the controls, and healing of fully scorbutic animals was even more delayed as demonstrated by the larger number of ruptured stomachs occurring in the latter group. The authors suggested that “The delayed healing of the scorbutic animals may be related to a deficient or imperfect deposition and maintenance of collagen.”

Use In Injury

In the case of a severe burn, fracture or wound, the animal's ascorbic acid requirements necessary for the proper deposition and maintenance of collagen are increased. These injuries may disturb the metabolism of the patient so that it cannot meet the increased ascorbic acid needs, either due to decreased production or increased demands over normal production. For this reason, it is advisable that in the case of severe fractures, wounds or burns, or in the case of slow healing of any of these types of injuries, the animal be administered ascorbic acid, or fed plenty of feed rich in ascorbic acid.

It has been shown that topical application of ascorbic acid to wounds produced no noticeable benefits, as stated in Nutrition Reviews, April, 1945 (4). According to Key and Elphick's interpretation of results attained with ascorbic acid therapy of guinea pigs by H. C. Han, Shanghai, China (9), the minimal scorbutic protective dose of ascorbic acid given by oral administration is twice as large as that given by subcutaneous injection. Part of the ascorbic acid given orally is possibly lost in the alimentary tract.

Sterility In bulls

Another aspect or indication of ascorbic acid therapy in veterinary medicine is in the treatment of slow breeding bulls. Most of the work done on ascorbic acid and sterility in the bull has been carried on by Paul H. Phillips and his associates, Lardy, Heuzer, Rapel, Werner and Zehner. Phillips (15) has found, by determining the ascorbic acid level in blood, that under a variety of conditions, cattle do not synthesize all the ascorbic acid they need. Under the conditions of ascorbic acid deficiency the breeding efficiency of some bulls becomes impaired.

There is another viewpoint concerning the vitamin therapy of sterility in bulls. Some workers have indicated that vitamin A is the deficient factor, and the correlation between vitamin A intake and reproductive efficiency is borne out by evidence that it is probably essential for the synthesis of ascorbic acid. It has been found that in chronic vitamin A deficiency there is a decrease of the blood plasma ascorbic acid, and that the administration of large doses of vitamin A in the form of fish oil is followed by the rise in the ascorbic acid level in the blood plasma and a partial, if not complete, restoration of reproductive efficiency in the bull (10).

Disappointments

Some practitioners have attempted to apply the ascorbic acid treatment in sterility of the bull and have met with disappointing results. The same has been true of some research workers, but all sterility in the bull is not caused by ascorbic acid deficiency. It should be used only in cases where a deficiency is indicated, as determined by laboratory analysis of blood plasma and semen ascorbic acid levels.

The ascorbic acid content of a normal bull's blood plasma ranges between 0.2-0.4 mg.% and that of semen between 3.0-7.0 mg.% (15). Phillips states, “Values below these ranges indicate a deficiency in the case of semen. Frequently values higher than 7 mg.% are obtained, and these cases, too, are amenable to treatment” (15).

It is advised that samples of the blood and semen of impotent bulls be sent to a laboratory for analysis of the blood plasma and semen ascorbic acid levels. The procedure is a tedious one and is not easily performed by the busy practitioner. Such samples should be covered with oil to prevent oxidation of the ascorbic acid. To determine the potency of the bull it is

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advised that the sperm be tested to determine their longevity when stored in a yolk-buffer. Phillips, et al., give these values (14):

- **Excellent potency** ........ 200 hours
- **Good potency** ............ 100-200 hours
- **Fair potency** ............. 100-150 hours
- **Poor potency** ............ 100 hours

It is also advisable that the animal's breeding record be examined.

**Subcutaneous Injections**

The method of treatment with ascorbic acid described by Phillips, et al, which is most applicable to the practitioner's needs is to dissolve ascorbic acid in sterile saline solution to make a concentration of from 10 to 20 per cent and to inject this solution subcutaneously, at the rate of 1 to 2 gm. per 1000 pounds of body weight, at three to four day intervals for five to six weeks (14 and 15).

It must be kept in mind that:

1. All sterility in the bull is not due to ascorbic acid deficiency, but ascorbic acid deficiency should not be overlooked as a possible cause of sterility.
2. Levels of over 6 mg.% of ascorbic acid in the semen may cause decreased viability of the sperm (16), and such cases queerly enough, are amenable to ascorbic acid therapy (15).
3. Oral use of ascorbic acid in the bull is ineffective since this factor is destroyed in the rumen. Therefore, subcutaneous injection must be used to obtain results.

**Periodic Ophthalmia**

Research conducted by Major T. C. Jones, Major Fred Maurer and Lieut. O. Roby, V.C., of Front Royal, Va., (11) concerning nutrition in periodic ophthalmia indicates that ascorbic acid deficiency plays a role in this baffling disorder. Analysis of equine ocular tissue revealed a very marked decrease of ascorbic acid in the ocular fluids, in the cases of periodic ophthalmia, especially during the acute stage of this disease. (The ocular fluids normally contain twenty times as much ascorbic acid as the blood.) By means of a fluorescein test, these workers demonstrated that the depletion in the ocular fluid is associated with the increased permeability of the ocular capillaries. This is probably due to a depletion of the intracellular matrix of the capillary walls; a common symptom found in scorbutic animals.

It is not known whether the ascorbic acid deficiency in the ocular fluids is a primary or secondary cause of periodic ophthalmia. It is thought that a deficiency of certain dietary essentials, especially riboflavin, may influence the synthesis of ocular ascorbic acid, or its protecting substances, which in turn bring on the lesions of periodic ophthalmia. As to whether or not periodic ophthalmia is amenable by ascorbic acid therapy, these workers did not state. It may be that the deficient factors affecting the ocular ascorbic acid are the therapeutic agents to use in such a case.

**Crystalline Form**

Crystalline ascorbic acid has been recently released again by the United States government, and can be obtained from the various veterinary supply houses. Synthetic ascorbic acid is fully as effective physiologically as the naturally occurring ascorbic acid (13). Crystalline ascorbic acid is recommended in definite deficiency cases, and in the healing of wounds, burns and fractures. It probably would be easier to give foods rich in this factor, concurrently with ascorbic acid injections, or eliminate the use of crystalline ascorbic acids altogether in mild cases. This would be dependent upon the ascorbic acid content of the foods alone.

Foods rich in ascorbic acid which can be fed to domestic animals are:

- Green forages
- Cabbage (especially high in ascorbic acid content)
- Sprouting seeds—(the vitamin is found only during the period of germination. Mature seeds and their by-products lack ascorbic acid.)
- Freshly drawn milk—contains a fair amount of ascorbic acid, but if the milk is allowed to stand the ascorbic acid is lost, since this factor is easily oxidized and destroyed upon exposure to sunlight.
Apples.
Meat (13), brain, liver, ovaries, testes and other glandular tissues.
Green leafy plants.

It is apparent that ascorbic acid rich foods which can be fed to herbivora are few in number. It is doubtful if any of the foods mentioned supply enough ascorbic acid when fed alone to supply sufficient amounts of this vitamin to be of any great therapeutic value. Hay, dry forage and grain contain no ascorbic acid.

Destruction

Ascorbic acid is destroyed in the rumen; hence no ascorbic acid, either from foods or synthetic products, can be successfully fed to ruminants. In species other than the ruminants, ascorbic acid may be administered per os, subcutaneously or intravenously, in a sterile saline solution. It must be remembered that it is necessary to double the hypodermic dosage for oral use. Better results are obtained with subcutaneous than with intravenous administration since absorption is delayed and the blood plasma ascorbic level remains elevated over a longer period of time following subcutaneous administration.

Conclusion

1. Research workers have proved that domestic animals may suffer a deficiency of ascorbic acid.
2. Ascorbic acid is essential in the healing of wounds, fractures and burns of experimental animals. Its use therapeutically for similar conditions in domestic animals would seem to be indicated.
3. Ascorbic acid deficiency may account for sterility in some bulls, and in such cases rational administration of ascorbic acid is generally of definite value.
4. There is some evidence to indicate that ascorbic acid deficiency is an important factor in equine periodic ophthalmia.
5. There are few foods which can be fed to livestock that contain enough ascorbic acid to be of any value. Crystalline ascorbic acid is the best available source of this vitamin for therapeutic administration.
6. Ascorbic acid is destroyed in the rumen and should be administered subcutaneously in ruminants.
7. Ascorbic acid may be administered per os, intravenously or subcutaneously in species other than ruminants. Intravenous administration is not recommended because of its transitory effects.

BIBLIOGRAPHY


The term “spinal column,” as applied to the skeleton of a quadruped, is a misnomer, derived, like most anatomy, from its analogue in man. The term, “column,” is inapplicable to quadrupeds. The word “spine” is also objectionable, as it is derived from the processes which superficially mark its course. There seems to be no objection to the term “vertebrae,” as a collective noun applied to whole or any number of its parts.