

Isotopes in Veterinary Medicine

progress in basic atomic energy research suggests similar advances in veterinary medicine

Logan M. Julian

The benefits of atomic energy will be measured—in part—by the evidence of solutions to those scientific problems which can be solved only by the utilization of isotope techniques.

A radioactive isotope is an elemental form which occurs naturally or may be produced artificially.

The internal energies of the nuclei of radioactive isotopes are so arranged that energy must be discharged—given off or emanated—in the passage of the atom from an unstable state to a stable one.

The fact that the emanation can be detected, plus the fact that the isotope of a physiologically important element cannot be differentiated by a living body from stable atoms of the element, makes the use of radioactive isotopes of value to biologists and the medical sciences.

The greatest benefits that veterinary medicine has derived from the use of isotopes are indirect—derived from the advancement of the basic sciences upon which the science of veterinary medicine is founded.

Techniques of Study

Three techniques are employed in the use of radioactive isotopes in medical research.

The *in vitro* technique involves the administration—by injection—of the isotope containing material to the experimental animal and a later analysis for radioactivity in the various organs and tissues. It is by this technique that most of the so-called simple tracer experiments have been conducted. Results of experiments of this sort have demonstrated—for instance—that the liver, spleen, and kidney take up phosphorus rapidly, whereas the brain takes up phosphorus slowly.

Studies using this technique have demonstrated an important fact in iron metabolism. The iron stores of the body are mainly controlled by absorption and not by excretion. That is, once iron is incorporated into the body, very little leaves. If the body requires more iron, it absorbs it; but if the body has an excess of iron, it appears that it has but limited means of ridding itself of the element.

A second method of isotope research is called the *in vivo* technique and involves the use of isotopes with radiations of sufficient energy that their presence

and concentration may be determined from the exterior of the body.

Radiosodium and radioiodine are isotopes emitting powerful gamma rays which penetrate the body readily, and thus allow simple detection by placing a Geiger counter over the part to be studied.

Radioiodine has been used to study thyroid metabolism. In this case, the counting device was placed over the thyroid gland and the concentration of the isotope in the gland studied.

The third method in the application of radioactive isotopes to biological research is termed the *radioautographic* technique. It is based on the fact that radiations from isotopes will expose photographic films, just as do X rays.

This method consists of exposing film to tissue which has been taken from an animal previously injected with an isotope. If radioactivity is present in the tissue, the radiations will expose the film; and the points of exposure may be correlated with the structure of the tissue. The value of this technique lies in the fact that it will define the cells or portions of a tissue which are the most active in the metabolism of the isotope under study.

Tagged Compounds

Organic compounds, synthesized to contain radioactive isotopes, have resulted in a very rapid advancement of the knowledge of intermediate metabolism, protein synthesis and toxicology of certain organic compounds. Once an organic compound contains an active atom, that compound is tagged and can be traced as long as the radioactive atom remains in its structure.

Radioactive carbon is the element of major importance in the synthesis of tagged organic compounds, although active sulfur has been employed in the formation of such biologically important materials as thiamine.

Fluid Balance

Fluid balance within the body is an important consideration in medical and veterinary practice. Proper volumes in the tissues, interstitial fluids, and the circulating blood must be maintained to insure satisfactory treatment.

The use of radioactive isotopes has presented new techniques for the determination of the various fluid compartments of the body. These techniques have in several cases proved more convenient or more successful than prevailing techniques and have proved useful in research on the effects of physiological and pathological conditions on the fluids of the body. These techniques involve the calculation of the dilution which has occurred when a sample of radioactive material has been mixed with the fluids of the compartment under study.

The total water volume of the body can be determined by the use of samples of radioactive water, prepared by the oxidation of radioactive hydrogen.

The combined volume of interstitial fluids and the plasma volume can be determined by the calculation of the sodium space with the use of radioactive sodium. The volume of the circulating blood can be determined by the use of a given quantity of radioactive red cells, and the calculation of the dilution of the cells which has occurred when they have had an opportunity to mix with the cells of the test animal.

Mineral Balance

Since fluid volume is related closely to mineral balance; it would seem that the combination of isotope studies on mineral balance and fluid balance should prove of use in elucidating such disease syndromes—grouped symptoms—as canine nephritis, many acute infectious diseases, and metabolic disturbances such as acetoneuria and eclampsia.

Mineral metabolism is an important subject to many aspects of veterinary practice. Not only do distinct clinical syndromes exist which are the result of faulty mineral metabolism, but the subject is important from early fetal life to the pathologies—illnesses—associated with advancing age.

The radioactive isotopes present valuable possibilities in the study of skeletal metabolism. From these studies has developed appreciation of the knowledge that the skeleton is not a permanent structure. This means that atoms which are incorporated into skeletal tissues do not stay there indefinitely, but at a later date

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Swine Values

body types and carcasses studied for development of a better hog

Peter C. Gaines

The carcass value of a fat hog is not always indicated by the dressing percentage, nor by the body type.

That fact was shown in demonstrations conducted coöperatively in Stockton by the University of California Agricultural Extension Service and the San Joaquin Farm Bureau Swine Committee.

Seven hogs were led one by one into the show ring. Producers and marketing experts judged each pig and appraised its value to a buyer, a packer, and a consumer.

After slaughter the pork was cut up and the weights of each piece were recorded.

Variation

There was a wide variation in the quality and carcass value among the seven animals.

The current day's market value of each cut was used as a guide to determine what each carcass was worth.

Six of the pigs graded choice and one graded good, at the stockyards, although all carcasses graded about the same.

The shorter hogs carrying the most finish definitely had the least carcass value. They had shorter bacons and loins which had to be trimmed heavily. As lard prices decrease, the short pig has less worth in relation to the intermediate pig not carrying so much backfat.

The carcasses of the longer hogs used in this demonstration were not excessively long and had a lot of depth and width which made them tend toward the middle bracket—the intermediate type of body.

The intermediate type carcasses rated good. The value was not so high as the two longest pigs but the difference was small and the quality was as good or better than that of the longer hogs. The proportion of lean to fat, general marbling, and the size and shape of cuts were excellent in the middle group.

The one hog which graded good at the yards had a very desirable carcass. It graded good because, from the standpoint of the packer, it had a minimum of backfat—it was not finished.

The shortest, chuffiest pig had a value spread of \$5 between the price the packer paid for it and what the wholesale cuts would bring. Under the same conditions one of the longer pigs would have returned \$12.50, over and above the stockyard price paid by the packer.

These two pigs of different types, purchased under present-day conditions, varied tremendously in their carcass value. The longer pig actually returned about 2½ times as much to the packer as the shorter pig, even though the live weight differed but little.

Animals which have a high carcass value dress out well but chuffy animals—those which are not wasty in the belly—may dress out rather high since dressing percentage takes into consideration the fat of the chuffy animals. When lard brings less than 10¢ a pound, the carcass value actually is reduced for this type of pig.

Grade Standard Suggested

A similar hog carcass study conducted by the University of Minnesota involved

the weight of the carcass, thickness of backfat and index-of-lean. The index-of-lean was determined by the combined weight of the hams, loins, bellies, picnics, and butts, plus the lean trimmings in terms of percentage of the total carcass weight.

At present hogs are sold on the basis of grade and weight. Producers, breeders, buyers, packers and judges have their own methods for evaluating a pork carcass. This lack of organization has fostered systems of breeding, types of fat hogs and marketing problems which emphasize the need for a unified program on the hog of the future.

The Minnesota study yielded a suggested Hog Carcass Grade Standard the validity of which was supported by the Stockton demonstrations.

The suggested standard is based on backfat, thickness and carcass weight. Length of carcass is second in importance to thickness of backfat in the measurement of value.

Backfat thickness and weight are considered to be the best simple devices to use in evaluating a carcass.

Thicker hogs usually have a lower index-of-lean percentage and the carcass has a lower value. As backfat thickness decreases index-of-lean increases but some of the cuts may not be good enough in quality to make No. 1 cuts from unfinished hogs.

Lighter weight carcasses are preferred by packers because consumers object to heavy cuts.

A great deal of progress has been made in the field of swine production but if the hog of the future is to be produced efficiently, further study is needed on the value of the carcass, especially from the standpoint of marketing.

The hog to be developed must be able to compete favorably with existing standards in economy of feed conversion, prolificacy, rapidity of gain, and all qualifications necessary for a continuous, stable industry.

Peter C. Gaines is Assistant Farm Advisor, San Joaquin County.

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are again released into the general mineral pools and are replaced by other atoms.

Calcium and phosphorous metabolism can be studied by the use of appropriate isotopes. This fact allows many direct and indirect studies upon bone metabolism. For instance, studies on the effects of various diets upon the mending of broken bones have been carried out. These studies involved the influence of vitamin deficient states upon the subsequent ossi-

fication—formation of bony tissue—and reestablishment of suitable breaking strength of broken bones. The studies have served to demonstrate a procedure by which the effect of various mineral deficiencies or intoxications upon bone structure may be studied. Flourine and magnesium are known to be concerned in bone physiology; yet unfortunately there are no suitable, easily employed isotopes of these important elements. Yet, the isotope technique may be employed by the use of the isotopes of bone which are related to these elements—calcium and phosphorus metabolism.

At the present time it would appear that radioactive isotopes will not immediately be applied to routine clinical veterinary use. Isotopes have not as yet been properly evaluated as therapeutic agents and there are inherent health hazards of the isotopes which at present are not fully appreciated.

The radioactive isotopes remain research tools which promise constantly enlarging knowledge to medical and veterinary sciences.

Logan M. Julian is Associate in Veterinary Anatomy and Associate in the Experiment Station, School of Veterinary Medicine, Davis.