United States Patent

Harris

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[54] **DEVICE FOR THE EXTRACTION OF CORE SAMPLES**

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[52] **U.S. Cl.** ....**128/2 B,** 17/52, 30/25, 30/280, 73/425, 128/305

[51] **Int. Cl.** **A61b 10/00,** A61b 17/32

[58] **Field of Search**.......128/2 B, 2 R, 305, 310, 311, 128/32 A, 347; 73/425; 30/25, 316, 279, 280; 17/52

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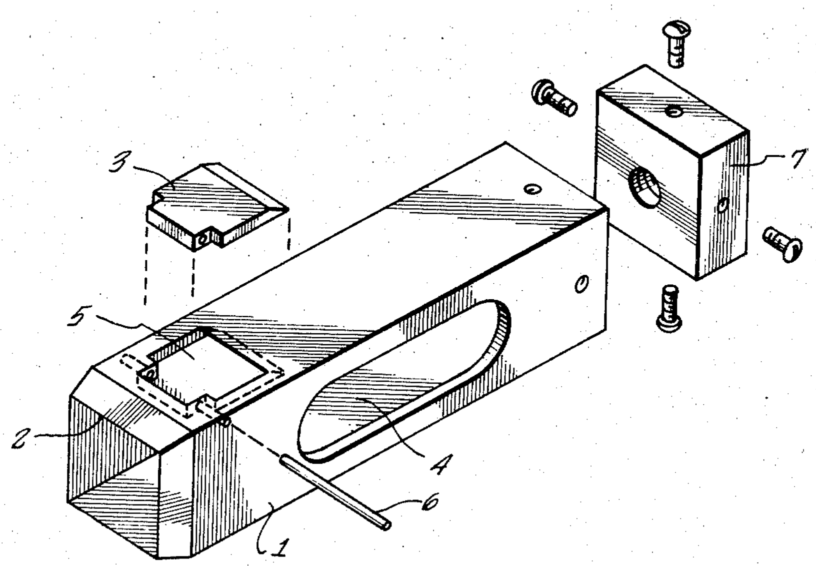
[57] **ABSTRACT**

Described herein is a device useful for extraction of core samples from, e.g., muscle tissue of live animals and carcasses. The device is comprised of an extractor body sharpened at one end and hollow to receive a core cut by the sharpened end as it advances into sampled tissue, the forward end of the body being provided with a blade inwardly pivotally responsive to, e.g., muscle tissue backflow to sever the base of the core from surrounding tissue. The extractor is preferably affixed to thrust-generating means which withdraw the extractor body and contained core from sampled tissue when a predetermined degree of advance has occurred.

6 Claims, 5 Drawing Figures



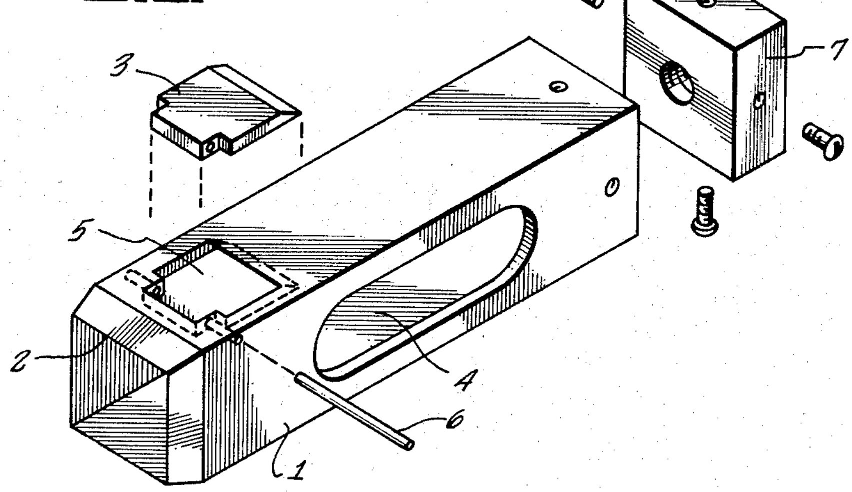


FIG. 1

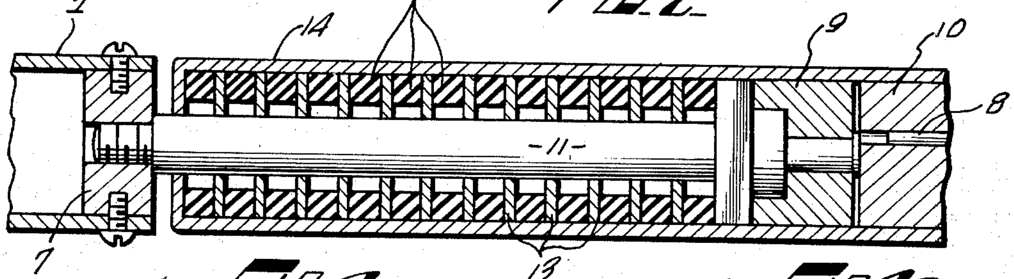


FIG. 2

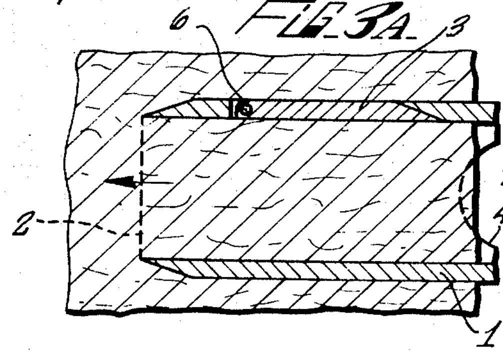


FIG. 3A

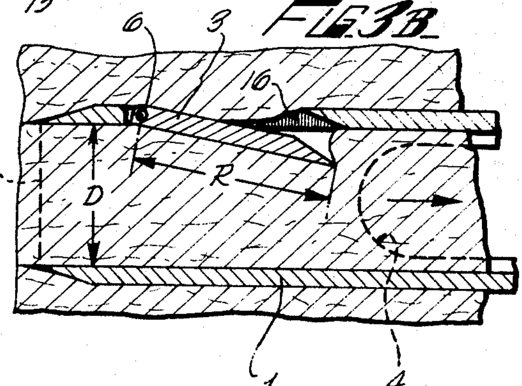


FIG. 3B

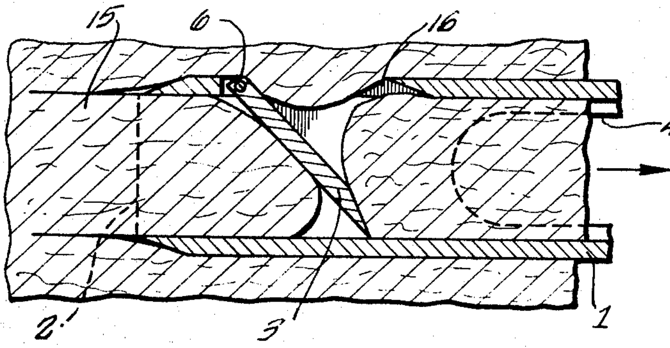


FIG. 3C

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DEVICE FOR THE EXTRACTION OF CORE SAMPLES

BACKGROUND OF THE INVENTION

Previously, muscle tissue cores have been withdrawn from the carcasses of meat producing animals for use in nutritional and food research. Consumer surveys have indicated that of the factors such as juiciness, aroma, flavor, and texture which contribute to the eatability of meats tenderness is the most important single attribute contributing to the acceptability of meat. Conventionally, tenderness is measured by resort to the well known Warner-Bratzler shear determination or alternatively, by submission of cooked meat samples to a tasting panel. In each case, the samples generally consist of one-half inch cubes of meat cooked to an internal temperature of 65° C. Correlation between sensory methods and the Warner-Bratzler shear is generally in the range of 0.60 to 0.85, with an average value of about 0.75. When the variability within sensory panels is considered, it becomes apparent that a correlation of this magnitude is quite significant.

It has been proposed to determine the tenderness of rail-suspended carcasses by manually pressing probes into the carcass, the probes registering resistance to entry on a strain gauge. Unlike the case of shear determinations of tenderness of tissue cores, no significant correlation has been established between strain measurements and sensory determinations of tenderness. The aforementioned strain determination is also unsatisfactory for tenderness determinations carried out on live animals because explosive force is required to penetrate the hide, whereupon the effect of the hide, fat layer, and the meat upon the stress readings must be isolated. Because tenderness and other meat quality characteristics are inheritable, tenderness determinations conducted with live animals could be employed in on-the-hoof grading and selection of breeding stock. Similarly, tenderness determinations on live animals could provide useful information to purchasers of cattle and other meat-producing animals. Absent significant correlation between strain determinations made on raw meat and sensory or shear determinations on cooked samples, and generally in view of the current state of the art vis-a-vis sampling from live animals, the removal of tissue cores continues to offer the most likely avenue to live animal tenderness evaluation. However, need has existed for core removal means suitable for expeditious sampling from large numbers of animals.

Prior art methods of extracting muscle tissue from live animals have been slow, inflicting pain, stress, and trauma to the animal and substantial risk to the operator. Those methods involve cutting a core with either a knife, scalpel or coring tube, followed by manual severing of the tissue at the attached end and removal of the severed core from the wound. Even in the case where a carcass rather than a live animal is sampled, severing the base of the tissue core has required an additional, time-consuming step. Consequently, a need has and does exist for a means of removing tissue cores from carcasses and live animals which is capable of fast, trauma-free operation.

BRIEF SUMMARY OF THE INVENTION

According to this invention there is provided a tissue core extraction device comprising an extractor body hollow to receive a core cut by the terminal edge of the forward end of the body, core base severing means being pivotally mounted adjacent the forward end of the extractor body to pivot inwardly upon withdrawal of the extractor body from a core channel cut by the said terminal edge, whereupon the base of the core is severed. One object of the invention is to provide a muscle tissue extractor suitable for operation in such fashion as to minimize the time a live candidate for sampling need be restrained.

Another object of the invention is to reduce operator risk and stress and trauma to the animal heretofore experienced in live animal sampling.

Yet another object of the invention is to provide a means by which the base of a tissue core can be severed without requiring a step separate from that employed to form the core itself.

A further object of the invention is to make possible large scale tissue sampling of live animals by a straightforward and efficient procedure.

These and other objects and advantages of the invention will become apparent from the more detailed description which follows, and from the attached drawing in which:

FIG. 1 is an exploded pictorial view of the core cutting and severing components of one embodiment of the instant invention;

FIG. 2 is a partial sectioned view of a preferred thrust-generating mechanism employed with the device of FIG. 1; and

FIGS. 3A, 3B, and 3C sequentially illustrate the cutting action of a preferred embodiment of this invention.

DETAILED DESCRIPTION OF THE INVENTION:

With reference now to the FIG. 1 depiction of a preferred embodiment of the invention, the forward end of an extractor body 1 is provided with a terminal cutting edge 2. When driven forward in the direction indicated by arrow in FIG. 1 into the longissimus dorsi, semitendinosus or other muscle tissue of a meat-producing animal, a core is cut by the said terminal edge and received within the hollow extractor body. Following severance of the base of the core by core severing means 3 and withdrawal of the core-containing extractor body from the sampled carcass or animal, the core is withdrawn from the extractor body by means of, e.g., core removal slot 4. Core severing means 3 is mounted in an opening 5 in a wall of the extractor body adjacent the forward end thereof in such fashion as to pivot inwardly about shaft 6, which latter is preferably journaled in opposed walls of extractor body 1. Means 7 are provided for affixation of a handle, thrust-generating means, or the like to the rearward portion of the extractor body. Preferably, the affixation means are comprised of a base block like that indicated at 7 in FIG. 1 for threaded attachment to the thrust-generating means, etc.

The method by which a preferred thrust-generating means is attached to the base block 7 is further illustrated in FIG. 2. With reference now to FIG. 2, conventional cocking and triggering mechanisms (not shown) are employed to activate firing pin **8** to strike and fire a .22 caliber blank cartridge held between chamber block **9** and restraining block **10**. The resulting explosion acts to urge piston member **11** forward, compressing a series of rubber washers **12** positioned about the piston between metal washers **13**. Because the piston is threadably attached to base block **7**, which is in turn attached by screws or other means to extractor body **1**, the forward movement of the piston **11** drives the extractor body forward as well. The "throw" or extent of advance of the piston can be predetermined by appropriate adjustment of the length thereof, the number and type of rubber washers employed, etc., as will be apparent to the art skilled. When the predetermined degree of advance has occurred, the spring action of the rubber washers causes the piston to retreat into its housing **14**, whereupon the extractor body which is attached thereto similarly retreats from the muscle tissue into which it has been forced by advance of the piston. In light of the above, it will be apparent to the art skilled that application of the advance-retreat principle exemplified by the thrust-generating means depicted contributes to the efficiency of core removal operation with which this invention is concerned. Of course, the invention can be employed in conjunction with other thrust-generating means such as those in which a metal spring supplants the rubber washer arrangement illustrated in FIG. **2**, other spring-loaded thrust-generating means, pneumatic or manual means, etc. Various modifications and refinements of the thrust-generating means will be apparent to the art skilled in light of this disclosure, e.g., the thrust-generating means of FIG. **2** can be hinged between the chamber block **9** and restraining block **10** to permit ejection of spent cartridges, etc.

The cutting action of the invented device is further discussed with reference to FIGS. **3A**, **3B**, and **3C**, which sequentially depict advance and retreat of the forward end of the extractor body **1** and contained core base-severing means **3** through muscle tissue. As the extractor body advances, the terminal cutting edge **2** cuts and advances through a core channel **15** forming a core which during the period of advance remains attached to surrounding tissue at its base. When the extractor body **1** has advanced to a predetermined degree, withdrawal of the extractor body from the core channel is commenced. At that point in time, the backflow of surrounding muscle tissue into the core channel and extractor body opening in which the core base severing blade is pivotally mounted causes the severing blade to pivot inwardly into the extractor body, as shown in FIG. **3B**. Tissue backflow, in combination with the forward movement of the core relative to the retreating extractor body causes that pivoting action to continue until, preferably, the core base severing blade is restrained from further rotation by the wall of the extractor body opposite that in which the core base severing blade **3** is mounted. That restraint can be provided simply by choosing the radius of pivot r to be sufficiently greater than the inside width d of the extractor body **1** as to prevent rotation of the core base severing blade through 90°. As shown in FIGS. **3B** and **3C**, the inward movement of the core base severing blade causes the core to be severed at its base from surrounding muscle tissue. Once pivot of the core base severing blade has been completed and further movement restrained by the extractor body wall opposite that in which the blade is mounted, the blade serves to retain the severed core within the extractor body during withdrawal of that body from the core channel.

As depicted in the attached drawings, the terminal cutting edge and cutting edge of the core base severing blade are simply tapered to form knife edges. Alternatively, of course, the various cutting edges can be formed by sharpening in two planes, hollow grinding, etc. Extractor bodies employed to date have been formed from square stock so as to obtain cores suitable for preparation of the cubical samples conventionally employed in sensory testing or Warner-Bratzler shear determinations of tenderness. Alternatively, of course, the extractor body could be circular or ellipsoidal in cross section, etc. In every case, of course, it is preferred that the core base severing blade be flushably fitted to the extractor body so as not to impede advance of the muscle tissue extractor into the tissue to be sampled. In this connection, it should be noted that the knife edge of the core base severing blade can be beveled to mate with a recess **16** formed in the rearward edge of the opening **5** in the extractor body wall in which the blade is mounted. Mating of the extractor body wall and core base severing blade edge in that fashion permits rapid advance of the extractor body into the tissue to be sampled and at the same time serves to prevent fortuitous pivotal movement of the blade outside the extractor body. Thereby, the "barb" action which would otherwise obtain and hamper retreat of the extractor from the core channel is prevented.

To date, backflow of muscle tissue has proved quite sufficient to promote inwardly pivotal movement of the base severing blade. That movement can additionally be encouraged by provision of barbed protuberances on the inner surface of the base severing blade or in other manners which will become apparent to the art-skilled in light of the foregoing disclosure. For example, the dimension r can be greater than the opening in the extractor body wall in which core base severing blade is mounted. In this instance the cutting edge of the blade "catches" the core as it moves forward relative to the extractor body upon withdrawal of the instrument. The mechanical advantage to be gained by provision of such supplemental means of promoting pivotal action must be balanced in every case against the impediments to advance of the extractor body created thereby, and to additional pain, trauma, or stress to the sampled animal which result therefrom.

In using the muscle tissue extractor of the invention, the animal to be sampled is placed in a squeeze chute and identified by its number. The position for sampling is located and the hair clipped as close to the skin as possible at that position. The position at which the incision is to be made is then disinfected and anesthetized. Anesthetization is preferably accomplished by placing a container partially filled with liquid nitrogen on the exposed skin for approximately 20 seconds. The 20 second exposure renders the skin sufficiently insensitive as to permit incision and core extraction without damaging the skin, hair, or muscle tissue. Unduly short exposure to the liquid nitrogen results in insufficient anesthetization, while unduly long exposure, e.g., in excess of about 25 seconds results in freezing of the skin so that cutting is more difficult. Care should be exercised to avoid contact of liquid nitrogen with the skin. Of course, anesthetization means other than liquid nitrogen can be employed, although that is the preferred course. Following anesthetization an incision is then made through the skin and fat layer. The length of the incision is dependent upon the size of the extractor body employed. If reasonable care is used, the animal usually displays no discomfort and remains calm in the chute. The extractor body is then gently placed through the skin incision and through the incision in the layer of external fat. When the fat has been completely penetrated, the thrust-generating mechanism is triggered. The extractor body instantaneously thrusts forward and cuts through the muscle. As withdrawal of the extractor body begins, the core base severing blade drops down and severs the tissue core from surrounding tissue. The extractor body with the contained core is then completely withdrawn. The wound is medicated with a topical disinfectant and the animal turned out of the chute. The cored sample is removed from the extractor body with a pair of forceps and deposited in a labeled container. Before further use, the extractor body should be disinfected and the mechanism checked to insure that no residue remains.

The invention is further illustrated with reference to the following example.

EXAMPLE

An extractor body 3⅞ inches in length and twenty-three/thirty-two inch square in cross section is formed from 4130 square tubing stock. The forward edge of the body is sharpened by ⅛ inch taper to a knife edge. A core base severing blade twenty-five/thirty-two inch in length by nineteen/thirty-two inch width is formed from 0.065 inch thick 4130 sheet stock, sharpened at one end to form a cutting edge and tapped at the opposite end to admit a shaft formed from 0.049 C/M wire. The shaft is employed to secure the cutting blade in an appropriately sized recess in the extractor body wall adjacent the terminal cutting edge thereof. A Remington Hand Stunner, Model No. 412 is modified to increase the throw piston thereof to an appropriate length and the piston threadably attached to a ⅝ inch square ½ inch thick base block formed from 1020 stock and attached to the rearward end of the extractor body by four screws. When employed for core sampling, a muscle tissue extractor of the dimensions given above consistently yields a core 5.0 to 6.3 cm. long, approximately 1.78 cm. wide, and 1.02 cm. thick. Of course, the dimensions of the muscle tissue extractor are primarily determined by the size of the particular sample desired.

Using a muscle tissue extractor like that described above, two experienced technicians performing the necessary surgical procedures, aided by three assistants, extracted longissimus dorsi muscle cores from 10 animals in approximately 25 minutes. An incision from about 5.7 to about 6.4 cm. in length is sufficient for a tissue extractor so dimensioned. Cores can be taken from both sides without apparent adverse effect upon the animals, and second cores have been successfully extracted adjacent the first where the space between the first and second coring position was not less than 6 cm. Most animals sampled showed no reaction to the coring procedure. Little external bleeding occurs and what little swelling is manifested starts receding by the third or fourth day following core extraction. Twenty days after core extraction the location of the incision can be only difficulty identified, healing of the skin being practically complete. Carcasses of animals slaughtered four days after tissue extraction show a slight slit in the fat cover where the incision was made. The lean muscle tissue had closed together, no open hole was visible, and the amount of bruising was slight. In most instances, the area displayed no more bruising than that which results from a typical grub infestation. In excess of 100 extractions have been performed from bovine specimens, with but a single resulting case of infection attributable to the coring procedure.

From the foregoing, it will be apparent that by the invention there has been provided an efficient and trouble-free means of extracting tissue samples from live animals. Whether live animals or, alternatively, carcass tissue is sampled, the invention permits core base severing without resort to the additional steps which have heretofore been required. By the invention the animal suffering and operator risk heretofore inherent in live animal sampling has been minimized.

I claim:

1. A device for the extraction of core samples comprising an elongated hollow extractor body having a terminal cutting edge on the forward end thereof, said extractor body being adapted to receive therewithin a core cut by said terminal edge, and severing means pivotally mounted in an opening in one wall of said extractor body adjacent the forward end thereof, said severing means extending from said pivotal mount in a direction away from said terminal cutting edge, said severing means having a cutting edge opposite said pivotal mount and a length greater than the internal dimension of said extractor body and adapted to pivot inwardly from said wall into said extractor body upon withdrawal of said extractor body from a core channel cut by said terminal edge, in response to backflow of material from which such core is cut, to sever the base of such core and retain the same within said extractor body to be withdrawn with said extractor body, and means associated with said body to permit removal of such core sample.

2. The device of claim **1** which additionally comprises thrust-generating means affixed to the rearward end of said body and adapted to drive said body forward with force sufficient to cut said core.

3. The device of claim **2** wherein said thrust generating means comprise advance-retreat means adapted to automatically retreat when a predetermined degree of advance has occurred, whereby upon retreat the said body containing said core is withdrawn from said channel.

4. The device of claim **1** wherein the radius of pivot is such that said severing means is restrained by the opposite wall of said body from pivoting through 90°.

5. The device of claim **4** wherein said removal means comprises at least one core removal slot intermediate the severing means and the rearward end of the body.

6. The device of claim 1 wherein the radius of pivot is such that the rearward edge of said opening serves as a stop preventing pivoting of said means outwardly of said body.

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