SPECIFIC GRAVITY AS A MEASURE OF PORK CARCASS LEANNESS

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The pork carcass is composed of numerous kinds of tissues, among which are fat, lean, bone, skin and connective tissue. Of these, the fat and lean are of greatest importance in pork carcass research, since it has been shown quite conclusively that the amount of bone is primarily a function of the age of the animal and the skin, usually difficult to separate from the subcutaneous fat, and is often included with it. The fat of the carcass is the most variable of these tissues, since it is easily altered by changes in the nutritional plane of the animal.

With regard to their densities, the fat and lean tissue of a pork carcass differ greatly. Fatty tissue is lighter than water, and lean tissue is heavier than water. If the percentage and density of skin and bone are constant for a given weight of carcass, then the lean and fat portions are the two principal variables, and their relative amounts in the carcass should be measured by a measure of density. It was with these ideas in mind that Brown, Hillier and Whatley (1951) of the Oklahoma A. and M. College made a study of specific gravity as a relative measure of pork carcass leanness (or fatness.) Animals to be slaughtered were taken off feed for twenty-four hours prior to slaughter. After chilling, the carcasses were air and water weighed. The half carcass was completely immersed in the water in the tank and attached by means of a string from the arm of a Toledo balance. (Illustrations.) This weight represents the amount that the half carcass weighed in excess of the amount that the displaced water weighed. Carcass measurements, yields of wholesale cuts and specific gravities were obtained on sixty-six pork carcasses from two different groups of hogs. Group I included thirty-four hogs from three in-bred Duroc lines and their crosses. These hogs gained from 1.12 to 1.59 pounds per day, and ranged in average backfat thickness from 1.38 to 1.93 inches. Group II included thirty-two individually fed out-bred Duroc hogs. These hogs gained from 1.48 to 2.21 pounds per day and ranged from 1.41 to 2.62 inches in average backfat thickness. The average specific gravity on all carcasses as determined by hydrostatic weighing was 1.027, with a range from 1.012 to 1.037. Intragroup correlations of specific gravity with area of loin eye, carcass length, percentage primal cuts, and percentage lean cuts were positive and highly significant. Highly significant negative correlations were found between specific gravity and backfat thickness, chilled weight, weight per inch of length and percentage of fat cuts. Correlations on Group II carcasses were slightly higher than on Group I carcasses. Specific gravity was more closely correlated with the above measurements than was backfat thickness or area of loin eye. The highest correlation was $+.84$ between specific gravity and percentage lean cuts. This work indicated the possible use of specific gravity as a measure of pork carcass desirability.

Whiteman (1952) further studied the usefulness of specific gravity methods in carcass work and obtained a multiple correlation coefficient of .912 between the specific gravity of the lean of the ham and the percentages of moisture, protein, and ether extract. This indicates that specific gravity

techniques were measuring the relative amounts of those constituents rather accurately. A correlation of .949 was obtained between the specific gravities of the ham and the half carcass which suggests that the specific gravity of the ham alone may be a good measure of carcass fatness. This work suggests that factors which effect the density of the water or the carcass may also affect a change and prove to be a source of error in the specific gravity measurements taken. The temperature of the water and surface tension of the carcass were found to be of minor importance in affecting specific gravity values. Carcass temperature, on the other hand, was found to have an influence upon specific gravity. The extent of this effect is unknown.

References

Brown, C. J., J. C. Hillier and J. A. Whatley, Jr. 1951. "Specific Gravity As A Measure of the Fat Content of the Pork Carcass." Journal of Animal Science. 10:97-103.

Whiteman, J. V. 1952. "A Further Investigation of Specific Gravity and Other Measures of Pork Carcass Value." Doctor's Thesis. Oklahoma A. and M. College.

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MR. KLINE: The apparatus we use right in the cooler. (slide shown) We generally have the tank full of water two or three days before we want to use it, so that the temperature, is pretty much in equilibrium with our cooler temperature, around 36° F. We use the full carcass and have a hook at one end that just goes through the place where the gambrel is on the hindleg, and then a couple of hooks are inserted on the other end, just in front of the breast bone.

MR. HENRICKSON: Do you get very much teetering of that carcass?

MR. KLINE: Yes, there is a little buoyancy. We have a thick coil in the damper on the scale which tends to slow it down rather quickly, but you do get quite a bit of teetering at that. It will take a minute or a minute and a half to quiet down.

MR. HENRICKSON: Have you ever tried suspending it from one position on the carcass rather than two?

MR. KLINE: No, we have not.

MR. MACKINTOSH: Might it be possible that there would be sufficient variation in the specific gravity of the bone to influence the specific gravity relationship that you otherwise get from the entire carcass?

MR. WALTERS: I would say that is very possible. Some work has indicated that as far as the bone is concerned, probably it is a factor or relationship related to age and maturity. With a group of hogs that have the same genetic background and are on the same general type of ration probably that sort of thing would be of slight importance in picking out differences in degrees of fatness in the carcass.

MR. MACKINTOSH: Could a correction be made by taking the specific gravity of some of the bones such as the femur?

MR. WALTERS: I don't know.

MR. HILLIER: We have worked on amount of bone as it might affect specific gravity. You take the bone and remove it all and get out the protein and get down to the ash and you don't have very much material. For specific gravity everything is the same as it is in the carcass, as far as we know, and it is the same for the protein. The only thing we are concerned about is the specific ash and that is just a very small amount. Around 25 per cent is actually ash and that is the only part we are concerned with.

MR. MACKINTOSH: What about the case of using deficiency rations?

MR. HILLIER: Possibly in extreme cases of age with probably the same weight. Specific gravity is as old as physics. The folks who use it with guinea pigs, rats, etc. indicate that something less than 5 per cent of their error was due to differences in bone as they calculated it. Whether that is true of pigs I do not know.

MR. MACKINTOSH: We had a wide range in the specific gravity of bones in working with deficiency ration.

MR. HILLIER: We have hesitated to put out a prediction formula, because those things get rather wide use and abuse. Of the variables that are really important, probably the most important one is the temperature of your carcass. Volume of carcass apparently varies with temperature. If you start with a carcass fresh off the kill, it definitely will float and probably will carry two to three pounds of weight. You chill it for 48 hours and it will weight 1200 or 1400 grams, something in that neighborhood, so that there is a volume relationship there to weight.

The temperature of the water does not seem to be too important, over the range that we would ordinarily get, but the temperature of the carcass apparently is to the volume of the carcass. After these carcasses have been in the cooler for some time their specific gravity goes down. They are lighter. There may be some gases developing in this tissue as it as it hangs in the cooler, over a period of four, five, six or seven days after slaughter. The weight in the water decreases after they have been in the cooler for some time. You must make that reading immediately after the carcass gets in its position and not wait for it to get watersoaked. I don't know what happens but it changes. The specific gravity will change as it lays there in the water. There are a lot of things about the method that must be standardized if it is to be used.

Under one set of laboratory conditions it is quite useful. To interpret it to someone else's conditions may be a little beyond us, at the moment.

Our last figure on this as correlated with ether extraction on a half carcass was .96 as against the chemical analysis for fat.

MR. KASTELIC: This change in volume as related with time is important. Apart from our own data I have not seen data which would indicate whether the relative change in volume in these different pigs is parallel with time.

The most precise measurement would probably be done on the pig immediately after slaughter. We would not have permitted conditions which would allow for loss of water, reduction in volume, etc. We would have to examine that point so that we are certain that the change of volume in a 200-pound pig is relatively the same as in a 250-pound pig.

It has been suggested that you take specific gravity when a certain internal temperature in the ham has been reached. That temperature change in a large ham or a large animal is different from that of the small animal. If you are going to do specific gravity readings on any large number of animals, it may mean your staying around in the middle of the night. We have been guilty of making readings of the whole lot at once which adds to the error that otherwise might be avoided.

What is the objection to taking the specific gravity immediately after slaughter? You would have to weigh the carcasses and add weights, perhaps to get calibration.

MR. HILLIER: You could add one large weight and then weigh back, one that you were sure would carry them under water.

MR. KLINE: We have followed about 36 carcasses, weighing them at 24-hour intervals over a week's time. We found that these lines do cross some times, and the specific gravity at 24 hours on two different pigs may reverse at the end of 48 hours. After about 96 hours the specific gravity tends to plateau and is fairly constant, but during the first 24, 48 and 72 hours there is quite an increase in the specific gravity, perhaps due to a decrease in volume shrinkage as the carcass hangs in the cooler.

MR. WALTERS: At Oklahoma, we usually take specific gravity readings at 36 to 48 hours.

MR. KLINE: Occasionally lines will cross and you will get some variation in the 24-hour period. We have to study more hogs before we can make any definite conclusion.

MR. KEMP: It seems to me that it would be a decrease in weight rather than in volume. When you hang carcasses in the cooler, they shrink more the first 48 hours, usually, than they do later on. Most of that shrinkage is water. If we lose 2 to 3 per cent of water, naturally we are going to have a higher percentage of fat. If we have a higher percentage of fat, isn't that going to lower the specific gravity, and then after 72 hours or so we don't have as much shrinkage, and that is probably the reason it would plateau.

MR. KASTELIC: If you check your calculation, the difference does not account for as much change in the specific gravity as is indicated. If you carry out that calculation, you will be convinced

that the loss in water from shrinking in the cooler is not as important as you might at first think.

What about holding some of these pork carcasses in the cooler in saturated atmospheres as concerned with water and have the humidity at the dewpoint, and then determine if this change, such as Mr. Hillier has brought to our attention might provide us with data which would answer the question you raised and others have.

MR. HALL: As the acidity built up in the muscle fibers contracts and shrinks and occupies less space that would account for an increase in the density of the particular fraction.

MR. MACKINTOSH: It might be interesting to make $_pH$ readings just before or after, maybe both, at the time you make your specific gravity tests. We know that the $_pH$ changes vary over a period of time after slaughter.

MODERATOR HENRICKSON: Colonel Kelley of the Veterinary Corps, will discuss the Babcock test for measuring fatness.

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