

REVIEW OF CURRENT PORK CARCASS AND LARD RESEARCH

E. J. WILFORD

UNIVERSITY OF KENTUCKY

The number of classifications used and the greatness of the volume of material on each will necessitate briefness which, in some cases, may be far too brief.

Type

Studies of the small-type versus the large-type from 10 weeks to 30 weeks of age, the smaller type averaged the fatter, and contained higher proportions of edible meat, and with advancing age the difference became greater. There was very little increase in the proportion of protein (fat free basis) in both types.

At uniform feed lot weights, the small type dressed highest and graded highest on foot and in the carcass. As type varied from large to small, width through the ham and shoulders, thickness of back fat, and plumpness of ham increased, as did the proportion of bacon, skinned back fat, leaf fat and fat trimming. There were corresponding decreases in the proportion of ham, loin, shoulder, and butt.

The finish of the hogs as indicated by the thickness of the back fat in relation to warm carcass weight increased as the hind legs became shorter in proportion to body length. Also from birth to market the average daily gain increased. From these studies it appears that a leg length of about two-thirds the body length seems to typify an excellent farmer-packer type.

Studies of the three types - large, small and intermediate - indicates that the latter type is intermediate in most all factors and thus most nearly meets the current requirements and readily lends itself to modification for meeting future changes in requirements.

Degree of Finish

Normal increases in fatness accompany an increase in live weight from 60 lbs. to 380 lbs., dressing yields increased from 67% to 80%. There is also an increase in bacon, cutting fat consisting of back fat, leaf fat, and fat trimmings; and a decrease in proportion of ham, loin, shoulder and head. These changes in proportions suggest a relatively heavy deposition of fat on the back, on the sides and belly, and in the posterior region of the body cavity. Rendered yields of lard increases from 175 pound hogs of 75% to 87% for 375 pound hogs.

The heavier the hog producing the cut, the higher is the caloric value per pound of product. Loin and ham produce the most protein. All cuts decrease; bacon the most rapidly, in proportion of protein, as the live weight of the hog increases.

There is a highly significant correlation between condition as observed by visual observation and thickness of back fat, which was found to increase with live weight. There was no correlation between the fatness of the pig and the development of the loin-eye muscle or the lean in the end of the ham.

Feed and Plane of Nutrition

A ration containing 10% manhaden fish meal did not produce "fishy" pork, but when 0.5% and 1.5% of fish oil was added off flavor and aroma were produced. Less fishy flavor was noted in the chops than in the roasts and bacon and was more pronounced in the fat. In addition undesirable flavors other than fishiness were found.

As to the plane of nutrition some investigators found that hogs fed a moderately restricted well balanced ration produced carcasses with a lower percent of fatty tissue and an increase in lean tissue as compared to hogs fed at higher levels.

Other workers found no significant relationship between the rate of gain in live weight either in the length or leanness of bacon carcass produced.

Soft Pork

As the percentage of fat was increased in the ration, the rates of gain were generally increased and the economy of feed utilization improved. That not much more softening fat (corn oil or peanut oil) can be fed than is present in corn without producing soft pork.

All carcasses examined early in the test were soft. The 0.5% and 5% fat levels increased in firmness and those fed 10%, 15% and 20% fat levels increased in softness. The outer layer of back fat was uniformly softer than the inner layer, but this difference became progressively less as the percentage of soft fat in the ration increased.

Soybeans raw or cooked produced soft carcasses. However, 43 pound pigs fed to gain approximately 40 pounds on rations containing 58.5%, 78.5%, and 92% of soybeans and subsequently fed to a weight of 225 pounds on corn with cottonseed meal and other supplements produced carcasses of satisfactory firmness. Even the pigs receiving the 92% soybean ration were graded medium hard.

Tests have shown that hominy produces soft pork. As hominy feed was increased in the ration there was a corresponding increase in the softness of the carcasses and bacon. Fifty percent was on the borderline as to quality, while the pigs receiving 75% and 100% hominy rations produced carcasses and bacon of definitely inferior quality.

Rice bran and rice polish produced soft pork but brewer's rice, rice screenings and rough rice produced firm pork.

Protein Level

The higher the protein level (9%-25%) the leaner was the pork produced. Lean to bone widened in hogs from 40 pounds to 225 pounds as the percentage of protein increased in the ration.

Vitamin Content

There is no definite relation between the amount of niacin in the ration and the amount stored in the liver. However, it was notably higher in the liver than in the loin and ham. Thiamine is stored rapidly in the pork muscle and seemed to reach saturation in 35 days or less. (50 mg. crystalline

thiamine daily). Thiamine deposition in pork is directly related to thiamine intake. Storage of thiamine occurs and it took pigs 50 to 60 days to lose appetites on a thiamine deficient diet.

Both thiamine and riboflavin are lost in cooking, 25% and 20% respectively.

In cured hams the following percent of vitamins were retained: thiamine 80%, riboflavin 97%, nicotinic acid 100%.

Curing

There was almost complete penetration of sodium nitrite within 15 days of hams, bacons and tongues. It was recommended that nitrite instead of the nitrate be used in sweet pickle and dry cure for bacons and hams.

The curing time of hams is materially lessened (3/4 to 1 day per pound of ham) by pumping (73% brine, 10% of wt.) and immersed in a pickle of the same strength.

Pumping hams with strong brine resulted in pocketing these solutions, with an uneven distribution of salt throughout the muscles. Arterial pumping produced a more even distribution of salt, which appears to be little influenced by pressures ranging from 10 to 40 pounds. Even gravity pressure gave good results.

The writer did not find any mention of one of the greatest dangers of spoilage in the pumping procedure, which is the neglect of removing all the air from the hose and needle before the injection of brine.

Freezing

As the period of storage for sausage lengthened the acid number and the peroxide number increased. Results show that no salt should be added to pork as the salt appeared to activate oxidation and resulted in rather rapid rancidity.

Pork may be preserved in frozen state under suitable conditions for 12 months and is edible at the end of 16 months. The desirability of the flavor showed a downward trend at 8 months and longer, mostly in the fat as the lean showed only a slight downward trend.

Stored at temperatures of 10° to 15° F. pork became rancid in 4 months, at 0° F. slightly rancid in 12 months; at -8° and -40° F. no rancidity in 14 months.

Meat heated prior to freezing (internal temperature of 158° F.) when stored at 18° F. was distinctly higher quality than comparable freezer-stored samples not previously heated. The difference in quality was unimportant when stored at 0° F.

Some tests indicated that there was no tenderizing effect upon quick frozen pork. That chops had a greater shrinkage than roasts.

Now as to wrapping and wraps, I will say that pork properly wrapped in good quality wrapping material that is substantial as well as moisture-vapor-proof will give good results. Pork must be processed as soon as possible

as aging is detrimental to its keeping qualities. Even pork coated with lard gave fair results, but an ice coating evaporated within a few days.

Breeds and Breeding

Carcass studies with Landrace hogs; three-fourths Chester White X one-fourth Danish Landrace; and Chester Whites, the following observations were made:

	<u>Danish Landrace</u>	<u>3/4 C.W. X 1/4 D.L.</u>	<u>Chester White</u>
Proportion of Ham	highest	lowest	intermediate
Proportion of Loin	highest	intermediate	lowest
Proportion of Bacon	intermediate	lowest	highest
Proportion of all fats combined	lowest	little difference between these two.	

Dehydration

Space will not allow me to do justice to this subject. Briefly - grinding after cooking resulted in more rapid drying; packed in tins was found to be most satisfactory. Vacuum rotary gave indications of combining the most good points; dehydrated meat that rated high in palatability, rated well in stability; when boned and when properly compressed volume was reduced from 65 to 73 percent. Fresh meat better than aged meat in preventing oxidation and rancidity.

Wiltshire Sides

Wheat gave faster gains than barley and barrows seemed more subject to carcass damage from heavy wheat feeding than gilts. The possibility of restricting total digestible nutrients during fattening is suggested. Smoked bacon may be stored satisfactorily for at least 2 months at -1° to -18° C. whereas unsmoked bacon was usually rancid after one month.

Lard

It is a well known fact that many feeds produce soft pork which in turn affects the quality of lard, especially its softness and smoke point. The percentage of free fatty acids as oleic, in fats tended to be inversely proportional to the smoke point.

Twelve hours frying did not produce disagreeable flavors in doughnuts, but 18 hours frying, both lard and hydrogenated vegetable fats, gave doughnuts an off flavor. Their smoke points were lowered considerably through reuse. The frying life of lard may be prolonged by storing in a cool place in tightly covered containers.

The digestibility of lard was superior to that of the other types of shortening used, with an average coefficient of digestibility of 94% (range 91.2--95.4%) as compared with the average of 87.5% (range 84.6--91.5%) for vegetable shortening.

Hydrogenation increased the firmness of lard and its keeping qualities, and raised its smoke point but seemed to lower its shortening power. Normal lard ranks near the top as to shortening value.

Improving the keeping qualities of lard has been accomplished by the use of inhibiting agents, known as antioxidants of which there are quite a number and thus due to shortness of time only a few will be mentioned. One of the best was vitamin E (A-Tocopherol). Nordihydroguaiaretic acid ($C_{18}H_{20}O_4$) (N.D.G.A.) has given excellent results under varied conditions. Even when exposed to light and kept in temperatures from 70° to 90° F., lard kept for 12 months. Most antioxidants when they come in contact with heat or soda lose their value.

I might say many of our Kentucky farmers are using this acid with excellent results in keeping open-kettle rendered lard much longer than normal for untreated lard. When used in the proportion of 4 ounces to 40 pounds of lard it is said that it will keep lard under most farm conditions of storage for 20 months.

* By a process known as the drip process lard has been produced, with a neutral white color, and neutral odor, having a smoke point about 450° F. and with a melting point high enough so that there is no separation at 113° to 115° F. The moisture content was 2/10 to 3/100 of one percent. This lard was rendered just as soon as possible after slaughtering and cutting with all protein and glue removed. The free fatty acid content was 5/100 of one percent and the stability was raised from 5 hours to 40--60 hours by the use of an antioxidant. This lard compares favorably with vegetable shortenings in all factors. A packer suggested putting lard into tins rather than cartons and suggested that recipes be formulated suitable for lard and advertised, as has been done for vegetable oils.

- - -

Sources of Literature

Conference on Cooperative Meat Investigations,
Report of Review Committee. Vol. V, 1946.

American Society of Animal Production,
Record of Proceedings, 1939 - pp. 125 and 305.

Journal of Animal Science
1942 - Vol. 1, No. 2, No. 4
1943 - Vol. 2, No. 3, No. 4
1944 - Vol. 2, No. 4
- Vol. 3, No. 2, No. 4
1945 - Vol. 5, No. 4
1947 - Vol. 6, No. 4
1948 - Vol. 7, No. 1

* The National Provisioner, April 10, 1948, p. 91.

The National Provisioner

Dec. 21, '46

Apr. 10, '48

Breeders Gazette - Sept. '43

Journal of Ag. Science, April '44, Jan. '45

Wallace Farmer - Feb. 16, '46; Dec. 7, '46; Oct. 4, '47

Farmers Advocate - July 10, '47

Scientific Agriculture - June '46; Jan. '46; Aug. '45; July '45.

U. S. Agr. Circ. No. 731, '45

U. S. Tech. Bul. No. 917, '46; No. 906, '45

Neb. Ag. Exp. Bul. 351, '43

Ohio Ag. Exp. Bul. 664, '46

Ark. Ag. Exp. Circ. 177, '44

Wash. Ag. Bul. 468, '45

P. Thos. Ziegler (Pa. State College) - Personal letter

National Live Stock and Meat Board Annual Report, Nos. 21, 22, 23

Food Research, 8, 1-12 (1943)

Ind. Eng. Chem. 26, 968-9 (1934)

Purdue Ag. Exp. Sta. Bul. 498, '44

- - -

CHAIRMAN TOMHAVE: Thank you, Professor Wilford.

PROFESSOR LOEFFEL: Are there any questions or comments?

PROFESSOR BULL: I don't agree with the statements regarding the keeping qualities of frozen pork; namely, that it will keep satisfactorily for a year. I won't eat the stuff after it has been in there three months, even when it is wrapped in aluminum foil.

PROFESSOR SNYDER: And when you use salt, if you use a good sage and pepper with it, it is an antioxidant. Therefore, you lengthen the life of that. Therefore, I think that ought to be included too.

PROFESSOR WILFORD: That's true. Of course, I had the material.

PROFESSOR SNYDER: Didn't you name that acid you were using? What's the name of that acid you were talking about?

PROFESSOR WILFORD: Nordihydroguairesic.

PROFESSOR SNYDER: I was thinking of the other.

PROFESSOR WILFORD: Acetic acid.

MR. HANKINS: You mentioned you lengthen the life by adding salt.

PROFESSOR WILFORD: No.

MR. HANKINS: You lengthened the life by adding antioxidants, such as sage and pepper.

PROFESSOR COLE: I have a question on these carcass measurements. In fact, I have two or three. One of these is: There seems to be a difference of opinion of where the belly of fresh pork side should be put, whether it should be in the lean cuts or fat cuts. There has been a tendency, I think, to put it in with the fat cuts, when maybe if you check on the prices, it's probably selling higher today than any other of our meats; that is, after it is cured, than is any of our other pork products. I just wonder if we are justified in putting it in as a fat cut?

PROFESSOR SNYDER: Was that not influenced by the nutritionists calling bacon a fat? I think maybe that might be one of the factors.

PROFESSOR COLE: But in our carcass work, when we are trying to develop the right kind of hog, where should we put it?

PROFESSOR HILLIER: I think along that line, possibly it is handled correctly in some instances, but when you review the work on carcass work in hogs, you are impressed with the variety of methods there are of dressing. That makes it very hard to compare the results of one station with another, for someone will give the dressing yield with the head on and the ham not faced, and so on; and in other cases they will have the head off and the leaf-fat out.

It seems to me that we would do well to agree on a definite method of dressing that was to be used. I realize that there would be some variations from one section of the country to the other, but if they were held to a minimum, I think we would get quite a little bit more from the data we do have and are getting, rather than having two or three different methods of dressing and cutting.

PROFESSOR LOEFFEL: I agree with you. We ought to standardize, or else report both methods.

PROFESSOR HILLIER: In too many of our reports the work has been done on methods that probably don't fit with the industry. I think there is a definite point in having our methods, our weights and our techniques fit with the general practices.

PROFESSOR WILFORD: That would be the head off and hams faced.

PROFESSOR HILLIER: Yes.

PROFESSOR BULL: On the other hand, if you take measurements, you have to leave this head on.

. . . There were cries of "Why?" . . .

PROFESSOR COLE: If you take a measurement, you wouldn't want to drop the head.

PROFESSOR LOEFFEL: Well, you measure length from the front of the aitch-bone, to the front of the first rib.

PROFESSOR BULL: Well, that is one measurement, but there is also the measurement from the tip of the toe to the end of the snout.

PROFESSOR LOEFFEL: What do you do officially on your R. P. work, Hankins? You drop the head, don't you?

MR. HANKINS: Yes, we measure head length.

PROFESSOR LOEFFEL: You leave the head on the carcass?

MR. HANKINS: Yes, we do. Then the body length, of course, is the distance from the first rib to the aitch bone.

VOICE: What is the head length?

MR. HANKINS: That's from the snout, between the nostrils to the rear of the Atlas joint, opposite the bone.

PROFESSOR LOEFFEL: Of course, you could take that after the head was off.

MR. HANKINS: Sure. Then we take the other measurement from the aitch bone to the toe, and we add those three together to get the total length.

PROFESSOR BRATZLER: I'd like to string along with Cole on that fat.

PROFESSOR LOEFFEL: I was going to ask Hankins. The question was raised as to the desirability of lumping the bacon in with the fat cuts, in view of the fact that bacon is one of the highest-priced cuts of the carcass. Our present plan is to lump it in with the fat cuts, is it not?

MR. HANKINS: Well, I don't know whether I follow you on that. We don't do that in our analysis. Of course, we think of it as a fat cut, yes, but if we stop to think about relative prices, then it's another matter. I hardly see how the belly could be thrown in with the balance of fat. That doesn't seem likely. I am more interested in throwing the belly in with the ham and the loin and the butt.

PROFESSOR LOEFFEL: Well, that's the question Cole raised.

MR. HANKINS: Realizing that the belly goes in one direction and the other cuts go in the opposite direction, but still, I think when you consider value, that's where the belly belongs.

PROFESSOR COLE: Of course, you have the other factor in that: When you get overly fat or short hogs, sometimes you have a thicker, heavier belly, and if you are trying to show differences in percentage in fat in a carcass, based on primal cuts, it doesn't give you a good picture.

MR. HANKINS: That's right. That's what I meant by saying the belly goes in one direction and these other cuts go in the opposite direction,

in terms of percentage. But still, from the standpoint of value, price, why they go in the same direction.

PROFESSOR COLE: I have two or three other questions I'd like to ask. One of them is: Why do we just cut one side of pork? Why don't we cut both sides? Now, I am basing that on the fact that you can go into the packing plant today and you won't find ten per cent of the carcasses that are split down the center, and in your meat labs, even though you are an expert splitter, I doubt if you ever split a hog exactly in half. That is one question.

Another one is: Why do we in some cases use depth and width of the longissimus-dorsi muscle, rather than a planimeter reading? It would seem to me like a tracing that can be kept and filed, and you can put a planimeter on it and get the exact measurement, it would be so much better than a depth length measure, for the longissimus-dorsi may be long or narrow, or may taper this way or that.

If someone can answer those questions, I have one more.

MR. HANKINS: Yes, my answer is that we don't. We cut both sides of the hog and we measure the eye-muscle with the planimeter.

PROFESSOR LOEFFEL: You cut both sides and average, don't you?

MR. HANKINS: Yes, put them together, calculate the yield on the total weight.

PROFESSOR COLE: But it isn't done that way at all stations.

MR. HANKINS: And to go a little farther on the longissimus-dorsi question, that goes back to John Hammond, I think. John suggested here ten years or more ago, based on some work with sheep, that the length and width relationship were important; and I think that is where it comes from, but we use a planimeter.

PROFESSOR COLE: Now, another question is: When you figure relationship of the area of the longissimus-dorsi side of the face of the ham, it seems to me that face of the ham could be off, because where are you going to face the ham? Are you going to have one inch, two inches, two fingers, three fingers? Is it going to be exactly the same every time, or should we get more definite measurements or correlation there?

MR. HANKINS: Well, I don't want to try to answer all the questions here, but I think the only correct answer to that question is that the point or line at which that ham is removed must be determined on a proportional basis, not on a two-finger width, or six-finger width, or anything else of that sort-- but a proportional basis. When you do that, I think you will find your correlation will stand up; but where you make it one inch or two inches or two fingers wide or four fingers wide, or something of that sort, I don't think it will, ever.

PROFESSOR COLE: Don't you think, though, that we are introducing quite a bit of individuality when we do that?

MR. HANKINS: When you do which?

PROFESSOR COLE: When you leave it up to the man to determine the proportions.....

MR. HANKINS: Yes, of course. Although I would imagine that if it were kept proportional in all cases, though the proportion might vary, then your correlation would stand up.

PROFESSOR COLE: It seems to me like a better measure would be to cut the ham right in two where we measure circumference; measure it there, rather than to face it.

PROFESSOR MACKINTOSH: I don't want to cut this short, but the discussion has a specific trend in my mind; and that is that there is need for a committee to continue the work that was begun by a committee of the Coöperative Meat Investigations in 1940, which was that of standardizing our methods of cutting pork. The war caused that to be cast aside. I think possibly before the day is over we can recommend that a committee be appointed to draw up standard methods.

We had that very forcibly brought to our attention this spring and last year in our frozen pork investigations using peroxide values. We found that peroxide values fit differently under parallel conditions at different stations. We began to investigate the conditions of determining peroxide values, and found that there are several factors that enter in which bring about marked variation. The result is that we have a project in the chemistry department at the present time endeavoring to develop a standard method with better control. I hope something will come out of it. I think that applies even more specifically to our method of cutting pork - likewise beef; you haven't as great a variable in beef as pork, but possibly I think any further discussion at this time would have a similar trend. It is something that we couldn't exhaust at this time, so I suggest we take it up later.

PROFESSOR LOEFFEL: In my judgment one of the important things to be accomplished by this Conference is to create an interest in meat research work, because there has been such a shift in personnel during the war years. So I think the objective here is to interest particularly the younger men in some of these research problems.

There are just one or two things which I'd like to mention. That is, a year ago the entomologists at our station developed a very excellent method for controlling hog mange - Benzine Hexachloride - with which one spraying did a very effective job of getting rid of the mange. It was also found it was very effective for killing poultry lice and mites; and we sprayed some poultry houses, and five months later put a few chickens in over night. They were slaughtered the next day, and the chickens were absolutely inedible, due to the presence of Benzine Hexachloride in the carcasses.

That immediately made us cagey as to what might be happening to these pigs, so we carried on some rather carefully controlled work this year, slaughtering pigs at definite intervals after spraying them with Benzine Hexachloride. We found that two weeks after the pigs were sprayed there was no objectionable flavor whatsoever remaining in the pig carcasses from the Benzine Hexachloride.

The California station has found the Benzine Hexachloride remains in the fat of cattle for 60 days after treating, and recommends that it not be used within 60 days at least of the time the cattle are to be slaughtered.

A short time ago we had E. W. Crampton down to visit us, and he mentioned one thing which interested me very, very much. That was with regard to their bacon pigs in Canada, that they need to hold their average daily gain below one and one-quarter pounds per day in order to get a high percentage of lean in their carcasses.

It seems to me in connection with the pork work too we should not let this opportunity pass without mentioning MacMeekan's work in Great Britain, which to me is an outstanding piece of work-- a piece of work which should inspire all of us to higher ideals in the way of meat research.

CHAIRMAN TOMHAVE: Thank you very much.

Our next speaker is the man who has traveled the greatest distance to come to this Conference. I think he also comes from the State where we always look upon lamb as being an important part of the livestock industry.

Professor Oliver of Oregon State will now discuss the: "Review of Current Lamb Carcass Research."

Professor Oliver.

#