Unexpected advantages followed application of Iowa's new hog feeding law, aimed at zoonoses. Lower death losses and heavier herds on a given volume of feed were bonuses in a public health program.

Garbage Cooking in Iowa

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AN IOWA LAW, which became effective June 1, 1953, requires the cooking of garbage fed to animals. The Iowa Department of Agriculture has the responsibility for enforcement. Regulations issued by the department state that garbage to be fed to swine in the State of Iowa shall be cooked or heated to 212° F. for 30 minutes by one or more of the following methods:

A. Wet steaming or boiling in an open vat.
B. Dry steaming or boiling in a jacketed kettle.
C. Steaming in a pressure cylinder.
D. Steam boilers.
E. Direct heating over an open fire.

A survey of the garbage-cooking installations in Iowa was made recently by Iowa State College personnel with the cooperation of the U. S. Bureau of Animal Industry. The survey provided information on the types of cooking methods being used in the field. This information was used as a basis for the selection of equipment to be used in laboratory studies that the engineering experiment station and the division of veterinary medicine at Iowa State College are now conducting on methods of cooking garbage. The project, titled "The Survival of Swine Disease Organisms in the Heat Treatment of Garbage," is being conducted under a grant from the National Institutes of Health.

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Garbage Feeders in State

Up to June 1, 1953, when the law went into effect, there were more than 400 garbage feeders in the State. Most feeders ceased feeding for several probable reasons: First, little was known about methods of cooking garbage; second, many feeders doubted that garbage could be cooked economically; and third, many feeders doubted that the cooked product would be eaten by the hogs. The number of feeders operating under the new regulations has gradually increased until by July 1, 1954, 13 months later, 60 garbage feeders were again feeding hogs. Since most garbage feeders in Iowa usually feed garbage as a sideline, they are comparatively small-scale operators.

As of July 1, 1954, 52 private feeders had been licensed to process garbage for hog food.

In addition to the private feeders, there were 8 garbage-processing installations located at Federal and State institutions, which do not require a license.

All of the garbage feeders collect, process, and feed commercial garbage, collected principally from restaurants, hospitals, hotels, food markets, and dormitories. Two feeders collect residential garbage and feed some of it along with the commercial garbage. Some handle a restricted type of garbage. Two feeders handle chiefly bakery-dough wastes, and two handle beef or swine offal and bones. The fuel costs vary from a negligible amount for the operator using scrap wood and tires to from 0.5 to 1.5 cents per hog per day for those operators using oil, kerosene, or bottle gas for fuel.

All of the feeders interviewed indicated that they were satisfied with the requirement that all garbage must be heat treated before feeding. They believed that feeding cooked garbage produced unexpected advantages in lower death losses and an ability to increase their herd size on the same amount of garbage.

On July 1, 1954, 5,275 swine were being fed in Iowa on heat-treated garbage. The average herd was about 88 swine; the largest herd of swine was 579 head, and the smallest was 26. During a normal month, about 1,000 garbage-fed hogs are sent to market from these farms. During the maximum month 1,898 garbage-fed hogs were marketed.

A summary of the various types of garbage-cooking methods used in the State is given in the table.

Two private feeders have not been classified as to method of cooking. One has not yet installed heat-treatment equipment, and his license is pending. The other is cooperating in the study at Iowa State College and is using all the types of cookers listed in the table. His equipment, therefore, would not be indicative of garbage cooking in Iowa.

Because few commercial cookers were available when the cooking law became effective, 70 percent of the cookers now in use are homemade. Sixty-four percent of the Iowa installations are direct-fired cookers, and of these 66 percent are homemade. The usual direct-fired cooker utilizes a flame in direct contact with the outer surface of the cooking vessel in which the garbage is contained. Most of the 25 homemade installations are simple, covered, rectangular or cylindrical tanks mounted on an earth, brick, or concrete block firebox. The farmer feeder usually utilizes oil as a source of heat, but the nonfarmer feeder, usually located on or near dumping grounds, uses waste tires or wood for fuel. None of the homemade installations visited was designed to use fuel economically.

Direct-Fired Kettles

All 13 commercial direct-fired kettles listed in the table utilize bottle gas, oil, or kerosene for heat. Frequently, the commercial direct-fired cooker is designed as a compact, trailer-mounted, double-walled tank heated with one or two burners. The hot flue gases pass back and forth through the space between the inner and outer walls of the cooker and heat the garbage effectively. Of the 38 direct-fired kettles, only

Garbage cooking in Iowa, in 52 private installations and 8 Federal and State institutional installations, July 1, 1954

Method of cooking	Number of installations	Type of construction			Type of fuel					
		Homemade	Commercial	Unknown	Oil	Coal	Wood or tires	Bottle gas	Kerosene	Unknown
Direct-fired kettles	38	25	13	0	13	0	15	8	2	0
Direct steam injection	17	15	0	2	5	8	1	0	0	3
Dry-steam coil	1	0	1	0	1	0	0	0	0	0
Dry-steam jacket	2	1	0	1	0	1	0	0	0	1
Pressure cooker	1	0	1	0	0	1	0	0	0	0
Not determined	1	0	0	0	0	0	0	0	0	0
Total	60	41	15	3	19	10	16	8	2	4

2 commercial, trailer-mounted cookers have mechanical stirrers to mix the garbage and assure even cooking. Observations and experiments by the authors both in the laboratory and in the field have verified the conclusion of the operators that the mixing devices provided are ineffective.

Direct-fired cookers normally have the disadvantage of high heat concentrations at the interface between the garbage and the garbage container. Unless the cooker is well designed, much of the heat is lost through the stack. Some of the advantages of this type of cooker are the rapid heating and the control of the moisture content of the garbage. The maximum amount of water in the garbage can be kept at a minimum with this method. The minimum amount of water, however, is fixed by the characteristics of the cooker and the garbage and is the amount of water necessary to prevent scorching or burning. Although the average commercial garbage is quite wet, all of the Iowa direct-fired installations require that some water be added to the garbage before cooking. Some operators have found it best to heat the water in the cooker before adding the garbage. This helps to prevent scorching or burning.

Direct Steam Injection

Direct steam injection is the second most common method of cooking in Iowa, and 29 percent of all installations are of this type. As the name implies, live steam is injected directly into the garbage to raise it to the boiling temperature. Most of the steam-injection installations are listed as homemade, since the cooking tanks or vats were designed by the operator and fabricated locally. All but one of the installations use commercial steam boilers for steam production. In this one a homemade, closed, cylindrical tank is used for a boiler and the fuel used is wood or old tires. No safety devices are provided at the boiler, and the authors regard this as very dangerous.

The tanks or vats in which the garbage is heated are usually rectangular, truck-mounted units equipped with a removable cover. Tanks are similar but not uniform in construction, and vary in capacity from about 60 cubic feet to 200 cubic feet. Most tanks have metal covers for heat conservation, although a few have canvas covers.

Two types of racks are in use for distributing the steam throughout the garbage. The first is a removable rack, which is a horizontal grid of pipes with a central steam-pipe header and several transverse laterals. Vertical lances of small diameter pipe are connected to the laterals. The lances are so located that they are spaced uniformly throughout the tank during cooking. Small holes in the vertical pipes permit the steam to flow into the garbage. This pipe rack is lowered into the garbage until the vertical lances penetrate to the bottom of the load. Most operators have found the lance-type pipe rack unsatisfactory because of the labor required to insert the lances into the garbage and because of the uneven steam distribution caused by the steam following the path of least resistance, along the side of the lances.

Although two installations still utilize the vertical lance-type rack, most feeders have converted to the second type of rack used in Iowa. This is a horizontal pipe rack permanently installed in the bottom of the cooking tank. Most installations use a header pipe across the front end of the tank and smaller lateral pipes running lengthwise of the tank. Numerous small holes drilled into the laterals are used for steam distribution. Lateral spacing, hole size, or hole spacing are not uniform. Only two installations are known to provide blowoff valves for clearing the steam lines of condensate and garbage liquor.

Direct-steam-injection cookers provide for maximum heat transfer from the steam to the garbage. A low overall thermal efficiency may sometimes be found, however, if the steam boiler or generator has not been well engineered. Steam produced by the common boiler or low-pressure generator may be a mixture of dry steam vapor and hot water. A boiler or generator in a good garbage-cooking installation should produce steam of high quality. The quality of steam is the percent by weight which is actually dry steam vapor.

The amount of steam required to cook a load of garbage depends upon many factors, including the amount of garbage in the load, the amount of water in the garbage, the temperature of the garbage and the surrounding air, the

physical nature of the garbage and cooker, and the quality of steam used. The hot water included in the steam mixture does not contribute any effective heat during cooking. A possible disadvantage of this method of cooking in colder climates is the large amount of water added to the garbage in the form of condensed steam. None of the feeders interviewed during the recent tour of Iowa, however, found any fault with the amount of water added using this method.

At least two feeders using the direct-steam-injection method of cooking attempted to use commercial steam cleaners for producing steam. The steam produced was found to average about 10–15 percent dry steam and 85–90 percent hot water. The excessive quantities of water added to the cooked garbage by using this low-quality steam forced the abandonment of these steam-producing units. All of the Iowa feeders using direct steam injection operate steam boilers whose steam quality is usually over 90 percent.

Dry-Steam Coils and Jackets

Dry-steam heating is the term sometimes applied to the method of heat application in which the steam does not come into direct contact with the garbage. Instead, the steam transmits its heat through an inner wall of a steam jacket or through a heating coil placed in the load of garbage. Five percent of all Iowa installations are of this type. An advantage of this method over the direct-injection method is the heat economy brought about by mixing the hot steam condensate with the cold make-up water and returning it to the boiler. As in the direct-fired method, Iowa feeders find it necessary to add water directly to the garbage to prevent the garbage from scorching. For this reason, one operator has constructed a combination truck-mounted, dry-steam and direct-steam-injection cooker. A false bottom about 2 inches deep has been built in the bottom of a rectangular tank. Permanently installed vertical lances spaced uniformly around the periphery of the tank lead upward from the false bottom. The vertical risers contain small holes to permit the escape of some steam from under the false bottom into the garbage. The operator believes that the garbage can be cooked faster and with less added water; but temperature checks by the authors do not substantiate the operator's opinion.

One feeder in Iowa uses a wet-rendering pressure cooker. Operators of a sausage plant in Iowa are processing the offal from their animals and their death losses for use as swine feed in a vertical, wet-rendering cooker. The offal and bones are cooked under 75 pounds per square inch of steam pressure for 14 hours. The installation combines direct steam injection with cooking under pressure to produce an excellent homogeneous product. The cooker outlet is located on the bottom and opens over an open-top farm tank. The inlet is located at the top of the tank. The offal is raised to the inlet by means of a bucket hoist. The cooked offal is dumped directly into the farm tank. The resulting cooked mass is quite fluid and the liquid is decanted off the top of the tank before feeding. The residue is virtually all edible.

"Cold Spots"

Recently about one-third of the Iowa installations were visited by the authors. Most of the cookers examined were found to contain "cold spots" in the tanks or areas where the temperatures of the garbage had not reached at least 170° F. when the cooking was supposed to be complete. No field test other than the mechanical location of cold spots in the garbage has been used to determine whether or not the heat treatment has destroyed the swine disease organisms. Interpretation of the Iowa law is that such cold spots should be brought to a temperature of 212° F. for at least 30 minutes. The temperature of the garbage during cooking must be permanently recorded on an acceptable temperature recorder. The operators have been instructed to locate the temperature recorder at habitual cold spots rather than in "hot spots." Methods for controlling garbage cooking to assure more strict compliance with the heating requirements for destroying swine disease organisms are being evaluated at Iowa State College.

All of the cookers were judged to be adequate to bring the garbage to a boil, provided the operator will conscientiously gauge his opera-

tions by the cold spots in his equipment rather than the hot spots. Sanitary procedure in handling the raw and cooked garbage as well as general sanitation around the cooker and pens appears to be one of the most easily broken links in the defense against swine diseases. The average feeder needs to know and to be impressed with the possibility of infecting his animals as well as those of others by laxity in conforming with the sanitary regulations. Accordingly, the average installation feeding cooked garbage is inspected by State and Federal inspectors from 12 to 24 times during a year. The authorities in Iowa are continually working to raise the standards of sanitation at these installations. As a result, a number of the feeders who operate marginal installations are making plans to increase their investment to improve sanitation and the cooking operation and to reduce garbage handling.

Liquidation Costs

The costs of installing garbage cookers in Iowa have been estimated to range from $50 to $3,000. In most cases, little consideration was given to the labor involved in handling and transporting the garbage during and after cooking. As a result, the garbage frequently must be dipped from the cooking tank by hand and transported manually to the feeding troughs. An increasing number of cooking tanks are being provided with chutes and doors to reduce the handling of the garbage. None of the feeders use grinding equipment to provide a more uniform garbage particle size, even though ground garbage would be easier to handle, would provide for more efficient transfer of heat, and would perhaps make more of the garbage available to the swine. Only two operators make any attempt to agitate the garbage artificially during cooking to secure more even heat distribution. The cost of the treatment is more than offset by increased income from their herds, for the hogs prefer the cooked garbage to raw garbage and a much larger percentage of it.

Conclusions and Comments

1. The Iowa law requiring the heat treatment of garbage resulted in a drop in the number of garbage feeders from over 400 to 60 feeders. The number of feeders cooking garbage has increased steadily, however, during the last 13 months and may be expected to continue to increase.

2. A majority of the cookers are homemade installations which were not designed for maximum heating efficiency or for fuel economy. Commercial cookers are, however, becoming more popular.

3. The direct-fired cooker is used most frequently for cooking garbage. Direct-steam-injection cookers are also used and are becoming more popular.

4. All of the operators interviewed report that they have gained rather than lost under the new regulations.

5. Only 5,275 swine were being fed cooked garbage in Iowa on July 1, 1954. On January 1, 1955, there were 73 licensed feeders in Iowa, feeding cooked garbage to 8,236 hogs. Six Federal inspectors from the Bureau of Animal Industry are now active in Iowa.