Pork Industry Handbook – Pork By-Products
Michigan State University
Cooperative Extension Service

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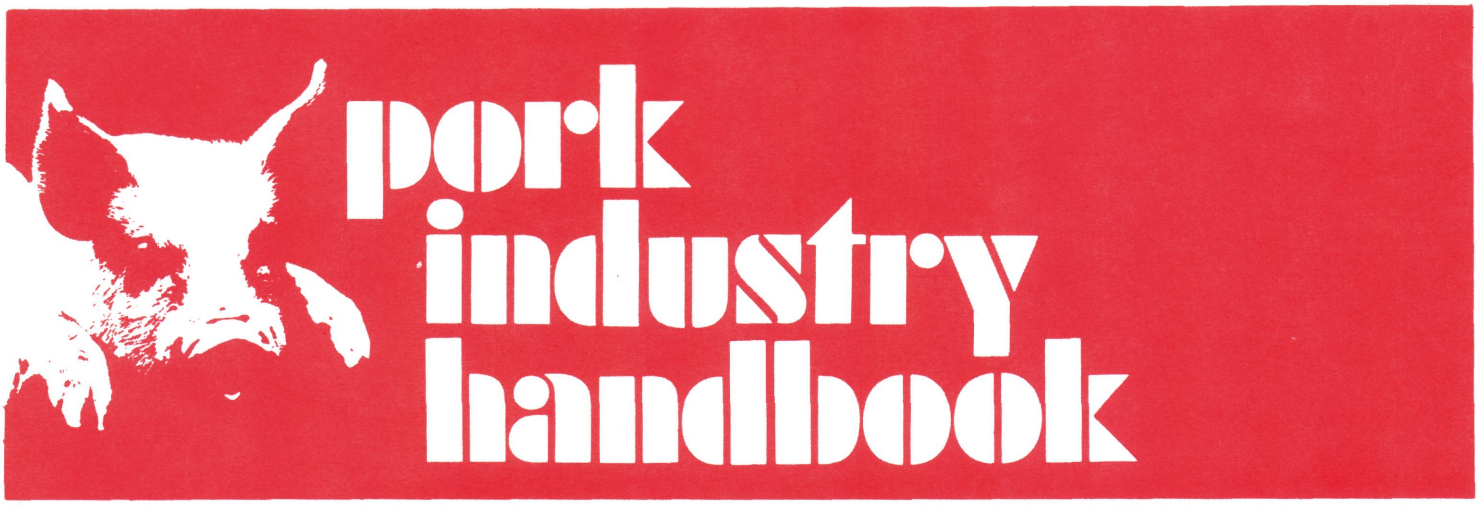

COOPERATIVE EXTENSION SERVICE • MICHIGAN STATE UNIVERSITY

Pork By-Products

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Mr. Tony Javurek, who guided two tours daily at John Morrell's Sioux Falls packing plant for more than 20 years, expressed the meat industry philosophy about by-products during each tour. Tony always said, "We use all parts of the pig except the squeal and the curl in its tail." This practice took place during prehistoric times when men and women used animal skins for clothing and shelter, bones and horns for tools, tendons and intestines for weapons, tools, and bindings; teeth, claws, feathers, and hair for ornaments; and skins for containers. Modern society learned well from their ancestors, and, as a result, today's meat industry utilizes many of the nonmuscle portions of livestock.

Meat slaughter by-products (offal) include all parts of the animal that are not a part of the carcass. Cutting and processing of the carcass result in nonmuscle by-products such as fat, bone, and other connective tissues. Processed by-products have been a significant source of income to the meat processing industry. The United States Department of Agriculture (USDA) Economic Research Service (ERS) (1990) reported the portion of gross farm value of swine attributable to edible and inedible pork by-products for the years 1985 to 1990 ranged from 5.6% to 6.3% and averaged 6.0%. Thus, if hogs are selling for $50 per hundred weight (cwt), $6.90 of the value of a 230-pound hog represents the worth of the by-products ($50 x 2.3 cwt x 6% = $6.90). Many different products and their predominant use are listed throughout the remaining pages of this fact sheet. However, at times market conditions and alternate product availability preclude the use which is listed in which case the item is used in a lower valued product.

The use of by-products is a controversial subject. One segment of society values the many products made available from by-products. There is, however, another point of view. There are concerns about the environment and the related energy costs. These concerns have made the use of by-products a major economic and management problem for the meat industry. Today, economics, modern technology, and the industry's concern for the environment result in maximum salvage and utilization of all by-product materials. A hog kill operation with a 1,000-head-per hour capacity must be able to process approximately 72,000 pounds of by-product material per hour. In many communities, the air and water effluent (flowing out) from meat operations must be as clean, or cleaner, than the water and air entering the plant.

Edible By-Products

Edible by-products, oftentimes referred to as "variety meats," are listed alphabetically in Table 1. The yields are based on a 230-pound hog along with a brief description of the use of each by-product. Prices for these edible by-products change, depending on their use and availability. Current prices are available from the following sources:

The Yellow Sheet, Daily Market and News Service, published five days weekly by:
The National Provisioner
15 West Huron Street
Chicago, IL 60610
Phone: (312) 944-3380

Market News, published weekly and the Blue Sheet published five days weekly by:
U.S. Department of Agriculture
Agricultural Marketing Service
Livestock & Grain Market News, Room 2623-S
P.O. Box 96456
Washington, D.C. 20090-6456

The Meat Sheet, published five days weekly by:
Meat Research and Reporting Service
643 South Route 83
Elmhurst, IL 60126
Phone: (312) 963-2252

Your state probably has a livestock and meat market news publication that is available to residents.

When you have interest in computing the value of these by-products, you can use the yield factors in Table 1 and the prices from your most readily available source.

Table 1. Edible pork by-products yields and uses from a 230-pound market hog (cont.).

By-product	Wt. (lb.)	Uses
Blood	7.0	According to the United States Department of Agriculture Food Safety and Inspection Service, no blood which comes in contact with the surface of the body of an animal or is otherwise contaminated can be used for food purposes. Only blood from inspected animals may be used for meat food products. In Europe, blood proteins are utilized in food to a greater degree than they are in the USA. Collection systems for blood have been developed in Europe which utilize cannula-like funnel devices for blood removal and some draw the blood directly from the animal's vascular system into sterilized, vacuumized containers. Blood is used in many different sausage formulations and in new cake mixes.
Brains	0.25	Sold in domestic and foreign markets. It is sliced thinly, breaded, and deep fat fried. Alternately broken into small pieces and mixed with eggs.
Chitterlings		Large and/or small intestines. Preferred quality comes from the middle 2.5 yards of the large intestine. Marketed seasonally in the U.S.
Ears	0.60	Generally exported to Latin America but also enjoyed in U.S.
Fat	25.0	Amount of backfat depends on the grade of hog. Lard provides a source of energy and an essential fatty acid (linoleic) for the human consumer; it is easily digested, since its melting point is near body temperature. Lard is useful as a cooking fat, a shortening, and a flavor ingredient in many foods. Unrendered fat is used in processed meat, soups, and snack products.
Feet (front)	1.4 each	Sold both in domestic and foreign markets.
Heart	0.6	Many are exported. They are normally split and washed. Some sold fresh to be cooked with moist heat. Most used in sausage manufacture as indicated on label.
Intestines		(Also see chitterlings) Sausage casings Small intestine -20 yards Large intestine -"Middle" 15-inch cap end (front end near small intestine) Bung afterend - one yard (front end of bung) Bung fatend - one yard (rear end of bung)
Kidneys	0.25 each	Sold to Western Europe for human food to be sauteed and served with a sauce. Many used in U.S. for pet food.
Liver	3.25	Small U.S. market for pates and braunschweiger. Excess goes to pet food. Some exported to Western Europe for human food.
Lungs	1.0	Some people of the world utilize lungs in processed meats, sausages, and stuffings. Most go to pet food in the U.S.
Maws (stomach)	1.5	Used in U.S. and exported to Mexico for soup.

Table 1. Edible pork by-products yields and uses from a 230-pound market hog.

By-product	Wt. (lb.)	Uses
Mechanically Separated Pork (MSP)		Yield of 21-27% from ham and picnic bones. Bones are coarse ground, then forced against a sieve to remove soft meat which flows through the holes. Use is limited and "mechanically separated pork" must be indicated by label.
Salivary glands	0.1	Used in Chorizo, a highly spiced, hot, dry Hispanic sausage.
Spleen (melts)	0.4	Edible in the export market; mostly used for pet food in the U.S.
Skin (whole skin)	10.0	Normally only skin off the back fat, fresh hams, and bellies is saved for human food, i.e., gelatin manufacture and pork rinds (snack foods). Gelatin finds wide use in desserts; in the manufacture of ice cream; in the making of certain pharmaceutical preparations and capsules for medicine; in the coating of pills; in the making of mayonnaise dressings and emulsion flavors; and in the clarifying of wine, beer, and vinegar. Pork skin is also used to manufacture cosmetics.
Snouts	0.65	Used in processed meat products.
Sweetbreads (pancreas)	0.25	Demand for human food is diminished, so most go into pet food.
Tail	0.25	Sold domestically for an ethnic market or exported to Latin America.
Testicles	0.40 each	From young animals preferred for human food, usually thinly sliced, breaded and deep-fat fried. Most go to pet food and to inedible products.
Tongue	0.75	Most exported to Western Europe and Japan. Some demand as fresh product and for canned and processed meat products.
Uterus	0.75	If saved for human food, exported to Far East to be used in Oriental dishes.
Weasand (esophagus)	0.13	Sausage manufacture.

Table 2. Proximate protein, fat and calorie content of 100 grams of selected cooked pork variety meats.

Variety Meat	Protein (grams)	Fat (grams)	Calories
Brain	12.2	9.5	138
Heart	23.6	5.05	148
Kidney	25.4	4.7	151
Liver	26.0	4.4	165
Lung	16.6	3.1	99
Pancreas (sweetbreads)	28.5	10.8	219
Spleen	28.2	3.2	271
Tongue	24.1	18.6	271

From Agriculture Handbook No. 8-10, Composition of Foods, Pork, 1983.

The nutritive value of selected by-products is listed in Table 2.

Because variety meats are economical sources of valuable nutrients, more extensive use of meat animal by-products for human food has been proposed as one method to reduce world nutrition problems. In addition to enhancing human nutrition, new developments in meat by-product utilization would increase the overall efficiency of livestock production. Variety meats are relatively high in protein; the exception is brain. Liver is the most nutritious of all meat items. The nutrient density of liver exceeds that of muscle meats, which are high. An excellent source of readily digested heme iron, liver also provides B vitamins, particularly B_{12}, as well as vitamin A to consumers who enjoy its unique flavor. (Heme is the O_2 carrying component of hemoglobin and myoglobin and is a source of iron more readily absorbed by the human digestive system than most dietary iron forms.)

Pharmaceutical By-Products

The medical arts have used animal products in the healing process for centuries. In fact, some animal products have held "magical" healing powers for certain societies throughout history. Similar conditions exist today with minute portions of certain animal extractives which are used each day and can literally be the difference between life and death for many humans. The pig is often used as a model for human research because of the similarity between the two species of several vital systems. Thus, most of the healing effects described below apply to pigs and humans.

Internally secreting, ductless endocrine glands are scattered through various parts of the animal body. The substance secreted by each exercises some specific control over the conduct, character, and development of the body. Their functions are so interrelated that under- or over-secretion of any one of several of the

glands will cause abnormalities. Hormones are some of the "magical" products which are derived from animal tissues saved by the meat industry and which are extracted, purified, and prepared for consumers by the pharmaceutical industry. Enzymes and other types of chemicals are also derived from animal slaughter by-products.

Adrenals

The adrenals are also called the suprarenal glands and are two in number. They are long and narrow and are located on the medial border of the kidney. They are reddish-brown in color and somewhat bean-shaped. The cortex (outer portion) produces steroid secretions essential to life maintenance. The medulla (inner portion) of the gland produces epinephrine which constricts the blood vessels and increases heart action. Each adrenal gland weighs approximately 1/2 ounce (14 grams).

Until recently hog adrenal glands were an important source of many different hormones which physicians used to treat illnesses or chemical imbalances in the human body. Now, many of these compounds are made synthetically.

Thyroid

The thyroid gland is dark and triangular shaped, about 2 inches across, may be located some distance from the larynx, has no isthmus, and somewhat adjoins the esophagus. Its secretion is an iodine-containing compound termed thyroxin. In the young, a deficiency of thyroid tissue causes a condition known as "cretinism," resulting in physical deformity and defective mentality, or idiocy. In the adult, it causes a condition known as "myxedema," defined as"severe thyroid deficiency" (hypothyroidism), characterized by dry skin and hair and loss of physical and mental vigor.

Forty fresh hog thyroids are needed to make a pound of thyroxin (14 grams to 21 grams per gland).

Parathyroids

Parathyroids consist of four small glands the size of a grain of wheat. They are located close to the thyroid gland. Their secretions regulate the calcium content of the blood stream and maintain the tone of the nervous system. The complete removal of the parathyroids causes death within a few weeks. To secure 1 pound of parathyroid extract requires the slaughter of approximately 3,600 animals.

Nervous System

Hog brains are a potential source of cholesterol, the raw material from which vitamin D_3, the "sunshine" vitamin necessary in building bones and teeth, is made. Cholesterol also comes from the spinal cord.

The hypothalamus, a small inner basal portion of the brain, produces relatively small molecules that cause the release of various hormones from the pituitary gland.

Pituitary

Located at the base of the brain and well protected in a separate bone cavity, the pituitary gland is about the size of a pea and is grayish yellow in color. It is made up of an anterior and a posterior lobe which have distinct functions. The anterior lobe is known to produce (1) the growth-promoting hormone (GH), (2) the thyroid-stimulating hormone (TSH), (3) the luteinizing hormone (LH), (4) prolactin, (5) the follicle-stimulating hormone (FSH), and (6) the adrenal-cortex-stimulating hormone (ACTH). The posterior lobe excretes hormones that (1) control blood pressure and pulse rate, (2) regulate the contractile organs of the body, and (3) govern energy metabolism. Pituitary glands in hogs produce a great number of hormones used to control human growth and metabolism problems and to regulate activity of the body's other endocrine glands.

Pineal

The pineal gland is about one third the size of the pituitary, reddish in color, and located in a brain cavity behind and just above the pituitary. Its secretion regulates early growth–hastening or retarding puberty and maturity. The hog's pineal gland secretes the hormone melatonin, which is used in treatment of personality and mental disorders. It also affects the color of the skin and the formation of freckles.

Stomach

Linings of the hog's stomach contain proteins and enzymes used in many commercially produced digestive aids and antacids.

Intestines

Heparin is classified as one of the "essential" pharmaceuticals and is obtained almost exclusively from the inner lining (mucosa) of the hog's small intestine and from the lungs. It is a natural anticoagulant used to thin the blood and dissolve, prevent, or retard clotting during surgery, especially during organ transplants. Heparin is also used as a gangrene preventative in cases of frostbite and as a burn treatment.

Enterogastrone, a hormone taken from the hog duodenum (beginning of the small intestine), is used to regulate gastric secretions in the stomach. It is also used experimentally to speed the emptying time of the stomach. Secretin hormone, also from the duodenum, stimulates pancreas glands to produce pancreatic juices. It is injected in humans to test for disease of the pancreas.

Liver and Spleen

Bile is synthesized in the cells of the liver and passes through the hepatic and cystic ducts to the gall bladder, where it is stored. Cholic acid has been purified from bile. It is an intermediate in the formation of chenodeoxycholic acid and ursodeoxycholic acid which are also derived from bile to be used in the treatment or prevention of gallstones. Catalase is an enzyme from the liver that is used in dairy processing, mainly cheese making. Splenic fluid affects capillary permeability and blood clotting time and speeds up recovery from inflammatory conditions (redness and swelling).

Testes and Ovaries

Hyaluronidase, an enzyme that attacks the complex glycoprotein, hyaluronic acid, found in joints and other connective tissues, is derived from testes. Hyaluronidase is used as a spreading factor to aid drug dispersion in connective and other tissues. Hog ovaries are a source of progesterone and estrogens used to treat various reproduction problems in humans. Sow ovaries are the major source of relaxin, a hormone often used during childbirth. It requires the slaughter of 145 female hogs to produce 1 pound of fresh ovaries from which corpus luteum and ovarian extracts are prepared.

Lungs

Lungs may be used as a source of heparin, but intestinal mucosal heparin extractions are more easily purified. Lung tissue is a source of a pancreatitis treatment product called aprotinin.

Heart

Hog heart valves from young pigs to full-sized market hogs are specially preserved and treated and surgically implanted in humans to replace heart valves that have been weakened or injured by rheumatic fever or through birth defects.

Pancreas

The pancreas is commonly known as the pork sweetbread, but it should not be confused with the commercial veal sweet-

breads (thymus gland). The pancreas has both internal and external secretions, the latter passing into the small intestine to effect the digestion of starch, protein, and fat. The internal secretion (insulin) regulates sugar metabolism. Failure of the pancreas to regulate sugar metabolism results in the affliction known as diabetes mellitus.

Diabetes was a killer disease before it was discovered that animal insulin could be used in humans. Insulin, first isolated by Drs. Banting and Best, is secured from specialized groups of cells in the pancreas known as the islets of Langerhans. Insulin is used extensively in treating diabetes.

The pancreas glands from approximately 60,000 hogs produce 1 pound of pure insulin, enough to treat 750 to 1,000 diabetics for one year. A year's production of 85 million market hogs could be the source of 1,400 pounds of insulin. The chemical structure of hog insulin most nearly resembles that of humans. This is significant because approximately 5% of all diabetics are allergic to insulin from other animals and can tolerate only insulin from hogs.

A product referred to as humulin is in production and replacing animal sources of insulin. Although priced higher, diabetics are increasingly using humulin. All newly diagnosed patients are put on the new product and many animal insulin users are being converted. This new product is a result of biotechnology and is replacing porcine insulin as biotechnological methods of synthesis become more efficient and cheaper.

Glucagon is a pancreatic hormone given to raise the blood sugar level and to treat insulin overdoses in diabetics, or when a low blood sugar episode is caused by alcoholism. It has a specialized use in the treatment of some psychiatric disorders. Kallikrein is a proteolytic enzyme from the pancreas which is also called kininogenase. It catalyzes a hydrolysis that forms kallidin. Kallidin dilates vascular smooth muscle tissue and thus reduces blood pressure. Chymotrypsin is an enzyme used to cleanse wounds and to remove dead tissue where ulcers and infections occur.

LPH (lipotropic hormone) is used as a digestive aid and is important in the digestion and absorption of fats and oils. Pancreatin is a mixture of pancreatic enzymes used to treat faulty digestion in humans. Because of its high-fat digestive capability, pancreatin is also used in the treatment of cystic fibrosis, a disease afflicting approximately 4 million people in this country.

Trypsin is a digestive aid that helps break down food by aiding in the hydrolysis of protein in the upper part of the small intestine. Trypsin and the enzyme chymotrypsin are prescribed to remove dead and diseased tissue from wounds and to speed healing after surgery or injury. Other extracts made from the pancreas, such as pancreatin, are used as a remedy for intestinal disorders.

Skin

Gelatin from hog skin collagen is used for coating pills and making capsules. Gelatin is taken orally to improve fingernail strength. See later discussion of pork skins as burn bandages. A porcine collagen product has been developed to stimulate clotting during surgery. The product is applied directly on the surface of the bleeding tissue.

Blood

Blood albumin from meat animals is used in human blood Rh factor typing. Blood fibrin extract from hog blood is used to make amino acids that are part of parenteral (infused as intravenous) solutions for nourishing certain types of surgical patients. Fetal pig plasma is important in the manufacture of vaccines and tissue culture media. Fetal blood contains no antibodies and is unlikely to stimulate immune reactions.

Thrombin, a blood protein, helps create significant blood coagulation. It is valuable in the treatment of wounds, particularly in cases in which the injury is in an inaccessible part of the body, such as the brain, bones, or gastrointestinal tract (as in the case of peptic ulcers). Thrombin is also used in skin grafting to help keep the graft in place and to "cement" gaps where tissues have been surgically removed.

Plasmin, a hog blood enzyme which has the unique ability to digest fibrin in blood clots, is used to treat patients who have suffered heart attacks. This proteolytic enzyme is combined with deoxyribonuclease from the pancreas to aid in the removal of dead tissue that results from certain vaginal infections. It is a valuable cleansing agent for infected wounds or clotted blood and can speed up the healing of skin damaged by ulcers or burns. Hog blood is also used in cancer research, microbiological media, and cell cultures.

Inedibile Pork By-Products

Fats

Meat slaughter and processing plants that have rendering facilities must have two separate rendering units. The two units must be separated physically to prevent any intertransfer of raw material, product, or contamination from the inedible-rendering area to the edible-rendering area. In pork operations, all soft tissue, some bones, sweepings, scrapings, and skimmings that are not classified as edible or do not have other uses are cooked and processed into inedible fat and meal by rendering. Dead hogs or condemned pork products are processed by inedible rendering facilities.

Rendered pork fat is known as grease. A major domestic use of grease is animal feeds. These fats are usually stabilized with an approved antioxidant to prevent rancidity development which would make the feed unpalatable. Fat is the richest food nutrient in terms of energy and as such has been used successfully in cattle, poultry, swine, and pet feeds. In addition to the energy value, fats reduce the dust, improve the color and texture, enhance the palatability, increase pelleting efficiency, and reduce machinery wear in the production of animal feeds.

During 1987, the pet food industry produced approximately 9 billion pounds of dog and cat food at a 1987 retail value of $5.7 billion. Comparable figures were $350 million in 1958 and $1.6 billion in the mid-1970s. Animal fats are used as energy sources, and meat meal is used extensively in some products for protein and mineral sources as well as for palatability enhancement. The pet and animal food industry utilizes some fresh by-products (uncooked) for canned and fresh frozen pet and specialty animal foods (zoo foods, mink food, racing and guard dog food, and fox food).

Fatty Acids

Fatty acids are obtained from animal fats through a process referred to as splitting and are used in ever increasing quantities in the manufacture of scores of products. The list of uses for fatty acids and other derivatives of natural pork fats by the chemical industry is extensive: biocides–substances destructive to many different organisms, cellulose processing, cosmetics, dyestuffs, explosives, fabric conditioners, foodstuffs, lacquers leather and paper goods, linoleum, lubricants, metal soaps, mining, mineral oil additives, plastics, road making rubbers, soaps, synthetic resins, tobacco, textiles, varnishes, and washing and cleaning agents.

Oils

Lard oil, made from "A" white grease, is used for making a high-grade lubricant which is used on delicate running machine parts. The oil from "B" white grease is sometimes called "extra neat's-foot oil" and is used in giving viscosity to mineral oils. The oils made from the brown grease are used in compounding cutting oils, heavy lubricating oils, special leather oils, illuminating oils, and are combined with paraffin in candle making.

Soap

Lard oil is also used for the manufacture of soap. Prior to the 1960s, the greatest utilization of grease had been in soap making. During the mid-twentieth century, soap production declined significantly, due primarily to the increased use of phosphate-based detergent powders and liquids. Domestic use of animal fats in soap has also been diluted by use of plant lipid sources. This development of detergents and other cleaning agents and replacement by vegetable fats posed serious threats to the market for the major products of the rendering industry. New markets were researched and developed in the feed industry, in the export market, and in application of fatty acids to industrial uses. The loss of a portion of the soap market stimulated the renderers to expand markets and diversify the products of the industry.

Modern soap making occurs in continuous processing systems which utilize fatty acids stripped from raw fats. Soap making originated and remained a batch process involving more time and less technology until the middle of this century.

Soap is biodegradable and therefore has an advantage over the phosphate-based detergents that replaced soap for many uses some years ago. Phosphates tend to accumulate in the water supply and are responsible for the stimulation of algae growth and oxygen depletion in lakes and streams. Fat-based cleaning products with detergent-like traits, effective in hard and cold water, have been developed and are in use in various parts of the world. Environmental concerns and fat utilization research have reinstated fat-based materials in the cleansing market.

Meat Meals

The dry, defatted, high-protein material which results from rendering varies, depending on the raw materials used and the processing technique employed. Protein products of rendering may be utilized in a number of ways but are marketed most extensively as animal feeds. It is necessary that the nutrient content and availability of feed ingredients be standardized, because animal nutritionists have detailed knowledge of specific nutrient requirements and are using computers to balance diets for specific amino acids and micronutrients. Animal protein sources used in livestock diets have not been well-standardized in the past. However, the U.S. rendering industry is installing rendering systems that result in less heat damage to nutrients and improved quality control of raw materials and handling. This is an effort to standardize rendered protein products. In addition to reducing variation in nutrient content and availability, the improved methods reduce potential microbial contamination of valuable feed ingredients.

Most nonfat products (of rendering) may be utilized as organic fertilizers. Some adhesives utilize animal proteins, especially blood meal or dried blood, as base materials. Bone meal is marketed to the manufacturers of china, instrument keys, steel alloys, glass, water-filtering agents, and enamels.

The major nonfat products of rendering are described below as feedstuffs, since that is the principle use of the materials listed. The International Feed Number (IFN), which is an identification system for feed ingredients, is indicated for each product.

Tankage, Digester Tankage, and Wet-rendered Tankage: IFN 5-00-386

The meat animal soft-tissue by-products and dead animal tissues have been rendered using direct steam-pressure (wet-rendering) systems. Dried blood is often added. The crude protein level is high (55% to 60%), but availability of and amounts of certain essential amino acids are low. Tankage is a good source of calcium and phosphorus.

Tankage, with Bone: IFN 5-00-387

The product has increased calcium and phosphorus levels (4.4 % or more), with a corresponding decreased protein level. It is similar to tankage but with a greater amount of bone.

Meat Scrap(s), and Meat Meal: IFN 5-00-385

The raw materials are similar to tankage but are rendered in steam-jacketed tanks (dry rendering). The lower processing temperatures result in improved protein quality. Dried blood is not added to meat meal, as is often true for tankage. When phosphorus exceeds 4.4%, the product must be identified as meat and bone meal.

Meat and Bone Scrap or Meal: IFN 5-00-388

The addition of bone to meat scrap increases calcium and phosphorus content and reduces protein; therefore, its value as a feed ingredient is reduced in some cases.

Blood Meal: IFN 5-00-381 spray, 5-00-380 meal, 5-26-006 flash

Dried blood is high in protein (80%), especially the amino acid lysine but unpalatable as a feed ingredient and has reduced digestibility. Flash dried (atomized into hot vacuum chamber) blood is a better quality feed source. Plasma is the watery part of blood left when red cells are removed. When spray dried, a process that does not destroy the fluid's protein and amino acids, it may be used as a protein supplement in pig starter diets. Blood products are used as adhesive bases and bonding agents.

Bone Meal, Steamed Bone Meal, and Special Bone Meal: IFN 6-00-400

Bones are ground and rendered to remove the fat and moisture, and the largely mineral remainder is reground. The composition may vary due to differences in raw materials or processing techniques and contains 7% to 15% protein.

Pigskins

Most U.S. pork processors have used or are presently using a scalding and dehairing technique which leaves the skin attached to pork carcasses until they are processed into wholesale or retail cuts. With such a system, the only fresh skin available of any consequence is that resulting from the fatback and the hams. This skin is largely used in gelatin production. However, more packers are removing the whole skin rather than dehairing, which results in pork skin usable for leather.

Pigskin is used as leather for gloves, wallets, handbags, brief cases, toiletry cases, tobacco pouches, book bindings, and leggings. The pigskin leather is tough and produces scuff-resistant footwear. The hog bristle (hair) is unique in that it grows through the skin from the follicle in the subcutaneous fat layer. The holes, or pores, through which the hairs pass, result in a naturally "air-conditioned" type of leather.

Scalded skins can be pulled using skinning equipment, but the leather becomes 10% thinner and has less tensile strength than does the leather from unscalded skins. The heat damage incurred during scalding makes many skins unsuitable for use as leather. Scalding is more labor efficient when done during the slaughter phase; additional labor is required to remove the skins at later stages of processing.

Specially selected and treated hog skins, because of their similarity to human skin, are used in the treatment of humans suffering from massive burns and injuries that have removed large areas of skin. It is also used in the healing of persistent skin ulcers. Hog skins are cut into strips or patches, shaved to remove the hair, split to 0.008 inches to 0.020 inches in thickness, and then cleansed, sanitized, and packaged. The skins are applied directly to the injured areas to decrease pain, inhibit infection, and prevent loss of body fluids.

Glue and Gelatin Stocks

The three main types of glue are hide glue, bone glue, and blood albumin glue. The latter is water resistant and is used widely in the manufacture of plywood.

The oldest and widest use for glue is in the furniture and veneer industry. Glue has so many varied uses that it has been said that glue holds the world together. It is used in sizing paper; in the manufacture of wool, silk, and other fabrics; in sizing

straw hats; in sizing walls that are to be painted; in sizing barrels or casks that are to contain liquids; on the heads of matches to make an air-tight cap over the phosphorus; in the manufacture of sand and emery paper to hold the abrasive on the paper; in the manufacture of dolls, toys, and ornaments; in the making of picture frames, mirror frames, rosettes, billiard balls, composition cork, imitation hard rubber, printing rolls, mother-of-pearl, gummed tape, paper boxes, calcimine, automobile bodies, caskets, leather goods, and bookbinding; and many other products.

The two types of gelatin according to their source are hide gelatin and bone gelatin. Both types of gelatin are used in the making of "facial" court plaster, in photography, in electroplating, as a bacteria culture medium, and for various other uses.

Blood

Whole blood contains around 21% protein. If the blood is allowed to coagulate, the gelled portion contains fibrin and cellular proteins, whereas the blood albumin remains in the fluid serum. The fibrin portion is sold as dried blood in tankage or fertilizer. The serum is clarified and dried and sold as blood albumin. Blood albumin is used in certain malt extracts and in fixing pigment colors in cloth and in finishing leather, clarifying liquors, and manufacturing glue. Blood is also used in the manufacture of buttons and imitation tortoise shell articles.

Hair

Hog bristles for making brushes were formerly imported from China but are now produced in the United States in increasing amounts. It requires considerable hand labor to collect the proper length bristles. It is found over the shoulder and back of the hog. The fine hair of most of our domestic hogs is not suitable for brush making; it is processed and curled for upholstering purposes.

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