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Recovery and Processing of Edible fat from Slaughter House Byproducts

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Abstract

Slaughtering of food animals not only provides meat but also provide valuable byproducts to the mankind. By slaughtering and processing of meat animal, only one third portion is meat while the rest of the portion includes byproducts and waste, which need to be adequately processed and efficiently utilized in various ways. Efficient utilization of byproducts has direct impact on the economy as well as environmental pollution. By products include meat and bone trimmings, blood, fat, intestinal content etc., among which fat is an important slaughter house byproduct which is used for edible as well as inedible purposes. Fat is obtained by rendering process, which may be dry, wet and low temperature rendering depending upon the utilization of finished product. Recovered edible and inedible fat may be used for various food and technical purposes which is directly or indirectly improves the economics of slaughter house industry.

Keywords: Slaughter house; Byproducts, Fat recovery; Edible; Inedible; Economics.

Introduction

M Meat is a highly nutritious food eaten by human beings since time immemorial. It provides high quality protein, important minerals, vitamins etc. with all of the natural advantages of animal food products; there still remains a great quantity, often in excess of 40% of animal byproducts. Slaughter house by products are basically left over after recovery of meat from food animals after slaughter. This slaughter house by products can be efficiently utilized to improve economy upto 7-11%. By products can be classified as primary (bones, blood, ingesta) or secondary (bone meal, blood meal etc.) by products. The quantity of animal byproducts available for utilization can be estimated by subtracting the dressing percentages, which fall into two categories: edible and in edible byproducts. Earlier this inedible fat was used prehistorically for lighting, softening and for preparation of waterproofing garments, but now a days it is used in various industries for making

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paint, soap, machinery parts, watches, lubrication oil etc.

Animals are slaughtered to produce their by products which can be well utilized for various applications in day to day human life, thus, contributing to the value of animals. Removal of fat from various parts of the animal body can be done by various methods, mainly dry rendering and wet rendering (Sharma et al., 2013). Rendering is the methods of processing of animal byproducts into important products of technical and edible use. It is the method of recovery of purified fats like lard or tallow from animal fatty tissue. It may be carried out at household level or small scale or large scale industrial level. The majority of raw material comes in form of meat trimmings, bones, fat, skin, hide and intestinal content abattoirs, restaurant grease, house kitchen and butcher shop. This material can include fatty tissue, bones, and offal, as well as entire carcasses of animals condemned at slaughterhouses, and those that have died on farms, in transit, etc.

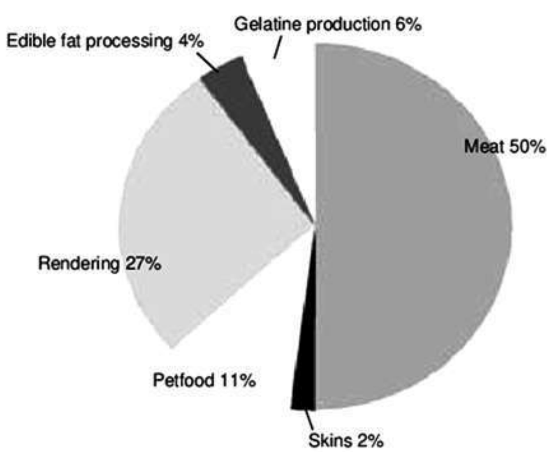

Fig. 1: Estimated utilization of slaughtered animal (by % weight) (Woodgate and Veen, 2004).

History

The development of rendering was primarily responsible for the profitable utilization of meat industry by-products, which in turn allowed the development of a massive industrial scale meat industry that made food more economical for the consumer (https://mavitecrendering.com). The earliest rendering was done in a kettle over an open fire. This type of rendering is still done on farms to make lard and tallow for food purposes. The development of an industry to utilize by products for fertilizer came during the nineteenth century. With the development of steam boilers, double jacketed steamers were used to product high quality heat sensitive products, where raw material would not come in contact with heating system. A further development came in the late nineteenth century with the use of the steam "digester" which was simply a tank used as a pressure cooker in which live steam was injected into the material being rendered. This process is a wet rendering process called "tanking" and was used for both edible and inedible products, although the better grades of edible products were made using the open kettle process. After the material is "tanked", the free fat is run off, the remaining water ("tank water") run into a separate vat, and the solids removed and dried by both pressing and steam-drying in a jacketed vessel.

The tank water was either run into a sewer or it was evaporated to make glue or protein concentrate to add to fertilizer. The solids were used to make fertilizer. Technological innovations came rapidly as the 20th century advanced. Some of these were in the uses for rendered products and others were in the rendering methods themselves. In the 1920s, a batch dry rendering process was invented, in which the material was cooked in horizontal steam-jacketed cylinders that were similar to the fertilizer dryers of the day. Advantages claimed for the dry process were economy in energy use, a better protein yield, faster processing, and fewer obnoxious odours attending the process. Gradually, over the years, the wet "tanking" process was replaced with the dry process, so that by the end of World War II, most rendering installations used the dry process. In the 1960s, continuous dry processes were introduced, one using a variation of the conventional dry cooker and the other making use of a mincing and evaporation process to dry the material and yield the fat. In the 1980s, high energy costs popularized the various "wet" continuous processes. These processes were more energy efficient and allowed the re-use of process vapours to pre-heat or dry the materials during the process

The rendering process simultaneously dries the material and separates the fat from the bone and protein. A rendering process yields fat (yellow grease, choice white grease, bleachable fancy tallow, etc.) at top most layer and a protein meal (meat & bone meal, poultry byproduct meal, etc.) at lower surface of digester. In this way, rendering process simultaneously dries the material and separates the fat from the bone and protein. The rendering industry today produces hundreds of useful products that can be broadly classified as edible and inedible oils, chemicals, meat meals, bone meals etc. these valuable products are produced from animal by products like viscera, bones, trimmings, dead stock, feathers etc. which were earlier usually considered as waste from the slaughter house and abattoir industry.

Rendering process for inedible purposes

Fat, meat trimmings and other slaughter house byproducts that are not suitable for edible purposes and used for various industrial and other purposes are the feedstocks for inedible rendering processes. There are basically two methods for rendering for inedible purposes:

1. Dry rendering it is done at 75 psi for 3-5 hours in dry renderer, where material is cooked in its own moisture. Dry renderer is a double jacketed horizontal steam jacket with load capacity of 8-10 quintals. The resultant material is known as crackling which is usually gritty, fibrous and non slippery. Fat is removed from this crackling inside the centrifugal expeller and fat settling tank.
2. Wet rendering it is carried out in vertical type steamer where steam directly comes in contact with raw material. It is cooked at 40 psi for 4-8 hours. After processing, the tankage or slush is allowed to settle for 2 hours, fat floats on the top which can be removed first, followed by water and finally by tankage with digested meat and bones (Sharma, 1996).

Fat recovery may be a batch or a continuous process at industrial level in which the material is heated in a steam jacketed vessel to drive off the moisture and simultaneously release the fat from the fat cells. The material is first ground, then heated to release the fat and drive off the moisture, percolated to drain off the free fat, and then more fat is pressed out of the solids, which at this stage are called "cracklings" or "dry rendered tankage". The cracklings are further ground to make meat and bone meal. A variation on a dry process involves finely chopping the material, fluidizing it with hot fat, and then evaporating the mixture in one or more evaporator stages. Some inedible rendering is done using a wet process, which is generally a continuous process similar in some ways to that used for edible materials. The material is heated with added steam and then pressed to remove a water fat mixture which is then separated into fat, water and fine solids by stages of centrifuging and/or evaporation. The solids from the press are dried and then ground into meat and bone meal. Most independent renderers process only inedible material.

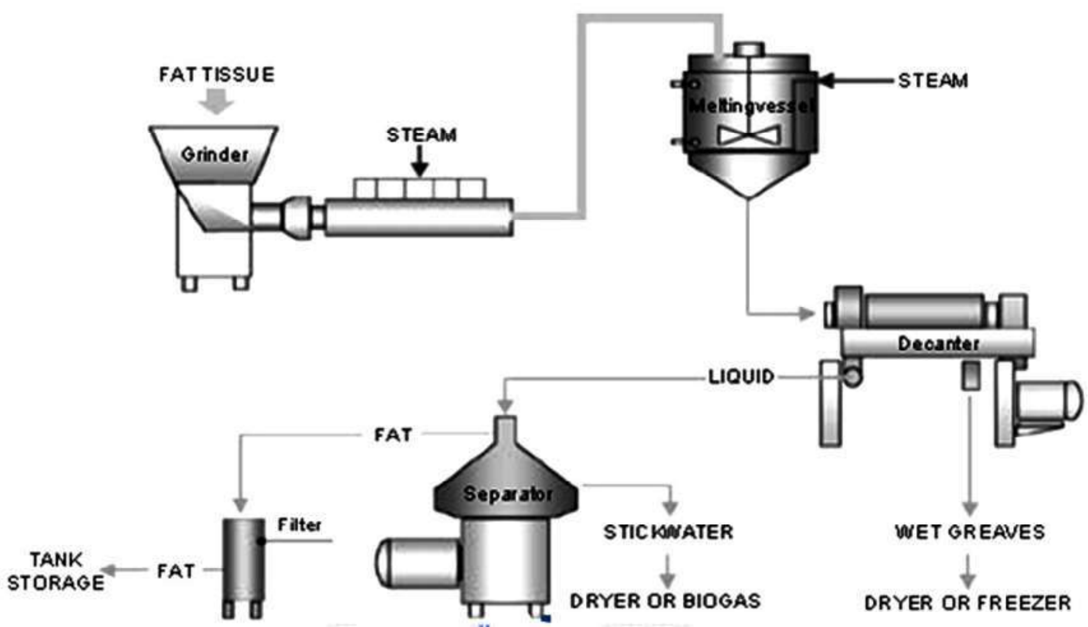

Fig. 2: Processing of recovered fat for edible purposes

Source: lipidlibrary.aocs.org

Low temperature or edible fat rendering

Edible rendering processes are basically meat processing operations and produce highe quality fat , normally used as food ingredients in culinary practices. Edible rendering is generally carried out in a continuous process at low temperature (less than the boiling point of water) at around 70-1000C (158-2120F), at this temperature raw material need not to be washed. The process usually consists of finely chopping the edible fat materials (generally fat trimmings from meat cuts), heating them with or without added steam, and then carrying out two or more stages of centrifugal separation. The first stage separates the liquid water and fat mixture from the solids. The second stage further separates the fat from the water. The solids may be used in food products, pet foods, etc., depending on the original materials. The separated fat may be used in food products, or if in surplus, it may be diverted to soap making operations. Most edible rendering is done by meat packing or processing companies. One edible product is greaves, which is the unmeltable residue left after animal fat has been rendered. An alternative process cooks slaughterhouse offal to produce a thick lumpy stew which is then sold to the pet food industry to be used principally as tinned cat and dog foods. Such plants are notable for the offensive odour that they can produce and are often located well away from human habitation.

Processing of recovered fat for edible purposes

There are a number of suppliers of oil and fat products used for edible purposes. These products include, but are not limited to olive oil, peanut oil, soybean oil, sunflower oil, shortening, butter, and margarine, but also the byproducts of slaughter house like lard, tallow etc. The raw materials for these products include animal by-products, fleshy fruits (palm and olive), and oilseeds. The crude fats and oils from these sources are recovered using a number of methods such as rendering, pressing and extracting with solvents. Some oils, such as virgin olive oil, are ready for consumption after this initial step (pressing), while other requires additional processing. The extent of fat and oil processing depends on the source, quality, and nature of the end use.

Alkali Refining

The growing demand for bland-tasting, stable oils and shortenings for the end user has driven the development of extensive processing techniques. The constituents of crude fats and oils that contribute to unwanted flavor and color are free fatty acids, waxes, color pigments, phospholipids (gums), oxidized products, metal ions, and carotenoids. Many of these undesirables can be removed by Alkali refining. Alkali refining is the removal of these unwanted items by a chemical reaction with an alkali (caustic soda).

This is process is completed by a four step process: Conditioning, Neutralization, Washing, and Drying. The fats are heated between 40° and 85°C and treated with an aqueous solution of sodium hydroxide or sodium carbonate. Conditioning transforms non hydrate phospholipids into their hydrate form by breaking down metal/phosphatide complexes with a strong acid. In neutralization the removal of free fatty acids and residual gums takes place. Washing is the removal of residual gums by hot water. And drying is the removal of moisture under a vacuum.

Inductivity Conductivity can be used to provide a continuous, on-line indication of the aqueous Alkali solution concentration. The aqueous emulsion formed by the impurities is drawn off the bottom of the tank (in batch refining) or centrifuged off (in continuous refining). After alkali refining, the oil is usually washed with water to remove any residual alkali or emulsion. Measuring the conductivity of this wash water can indicate its quality. Clean water with low dissolved solids will exhibit low conductivity.

Water Refining

Also known as degumming, water refining consists of treating the crude oil with a small amount of water. "Degumming" is where phosphotites in the Oil are hydrated with water and then removed by separating in the Centrifugal Separators. The Degummed Oil is then subject to neutralization with caustic soda where the free fatty acids are converted into residual gums and are separated in hermetic separators. The neutralized oil is then washed and dried (Fidel et al., 2020). The "gummy" emulsion of phospholipids created by the treatment with water is then centrifuged off. In the case of corn and soybean oil, this emulsion can be dried to produce a substance known as lecithin, which is used as a emulsifier in many applications. Because of this, the water used in the degumming process needs to be of high quality. Any impurities in the water will end up in the product after the drying process. Once again, conductivity can provide a low maintenance indication of water quality.

Deodorization

Most fats, even after refining, have characteristic flavors and odors, and vegetable fats especially have a relatively strong taste that is foreign to that of butter and are considered undesirable. In order to produce a tasteless, butter-like fat, these oils may undergo deodorization. To do so steam is blown through the heated oil to distill the volatile components responsible for these flavors and odors. Of course, in order to generate steam you will need water, clean water. pH and conductivity measurements of the feed water are mandatory in this process to ensure the protection of the process equipment from corrosion and scaling. Other than water, you need heat to generate the steam. Proper control of excess oxygen in flue gas allows the boiler to be operated efficiently and safely.

Hydrogenation

For many purposes, it is desirable for the oil to be solid, or semi-solid (margarine and shortenings). The process that converts liquid oils to higher-melting solids is called hydrogenation. The process consists of dispersing hydrogen atoms to double bonds of a molecule through heated oil in the presences of a catalyst. Cylinders from a vendor may supply the hydrogen, but some plants produce it on-site. This usually involves the electrolysis of water to form oxygen and hydrogen. It is critical for the water used in the process to be pure. Contacting conductivity can be used to ensure the quality of the water in order to prevent damage to the expensive equipment used to generate the hydrogen. The purity of the hydrogen used in this process is critical, both for the product quality, and the process efficiency. There are many points in the processing of edible fats and oils that benefit from the use of analytical measurements. Inductive conductivity, contacting conductivity, gas density and pH can be utilized to increase the quality of the end product, as well as protecting expensive process.

Conclusion

Present day health conscious consumer requires food ingredients with improved quality in terms of nutrition, safely processed and good for health. Rendering of fat and other slaughter house byproducts with different methods produce product of various industrial, technical (grease, animal feed, soap, candles, biodiesel, and as a feed stock) and edible uses. Edible fat recovered from processing of slaughter house byproducts will not only improve the economics of abattoir industry, even will help to provide fat of superior quality for culinary purposes at lower price.

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Web Source

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