

SALVAGING AND UTILIZATION OF SLAUGHTER HOUSE BY-PRODUCTS

V. Kesava Rao, Professor & Head
Department of Livestock Products Technology
Rajiv Gandhi College of Veterinary & Animal Sciences
Kurumbapet, Pondicherry - 605 009.

Animals are normally slaughtered for producing meat for human consumption. While slaughtering food animals, apart from meat a number of edible and inedible offals also emanate. Slaughter house by-products may be defined as everything obtained from the abattoir or butcher's shop that is not sold as food. The definition of by product is rather vague. Basically, the terms by-products and offals are used to denote every part and particle which is not included in a dressed carcass. In large animals such as cattle and buffaloes by-products yield is well over 50% of the live weight of the animals.

India possesses largest animal population in the world and livestock occupies an important place in our economy. Total meat production was about 4.69 million tons in the year 2000 (FAO, 2000) from the slaughter of around 22 million large animals (cattle & buffalo), 70 million sheep and goat and 11 million pigs besides poultry. A huge quantity of slaughter house by-products are produced in the process of meat production because 50-60% of the animal's live weight is by-product. The optimum utilization of by-products is very important for successful running of a meat plant and for better return to livestock produces. In an organized meat plant about 30-35% return is estimated from the proper utilization of by-products. It was reported that India's loss on account of not utilizing slaughter house by-products was in order of US \$70 million per annum. The reasons for under utilization or non utilization of slaughter house by-products are reported to be lack of modern abattoir facilities, lack of proper scientific and technical competency and lack of transfer of technology from laboratory to industry.

By-products from small ruminants (sheep & goat)

About 70 million goats and sheep are slaughtered annually producing about 0.69 MMT of meat and substantial quantity of various by-products. Most of the by-products from small ruminants are sold as food as they have good consumer demand from the certain section of the society. Except bile, glands, hooves, ruminal content, skin and to some extent blood all the items are sold at various rates to the consumers. Skin has good market value and find their way to tannery for further processing. In slaughter houses with good throughput, most of the intestines are processed for preparation of casings using old

traditional technologies. Casings are utilized for sausage preparation and command a good overseas market. It has been observed that there is little scope for processing of by-products from small ruminants due to paucity of raw materials. However, ruminal contents and under utilized blood can be used for ensiling.

By-products from large animals

A huge quantum of primary by-products viz. blood, hide, horns and hooves, bones, hide trimmings, glands, bile and other available daily from the large organized slaughter houses all over the country which need to be collected hygienically and processed economically to realize the full potential of the meat industry.

Utilization of blood

In spite of having high nutritive value, blood is one of the most under-utilized slaughter house by-products and by utilizing blood, pollution capability of slaughter house effluent can be reduced to a greater extent. Blood can be suitably processed to prepare protein isolates (serum protein isolates and globulin protein isolates) for successful incorporation into food products.

Table 1: Blood protein production in India

Species	Total population 1000 heads*	Slaughter 1000 heads*	Blood yield 100 lit**	Blood Protein 1000kg*
Cattle	194600	12454.4	124544.0	22417.9
Buffalo	79500	8745.0	78705.0	14166.9
Sheep	45000	14085.0	21127.5	3802.95
Goat	119400	46924.2	46924.2	8446.36
Pig	11900	4200.7	10501.7	1890.31
Total			281802.4	50724.4

* FAO (1995) ** Calculated on the basis of standard data

Source: Mandal et al. (1999)

Besides use in foods, blood has greater pharmaceutical use for production of biochemical and pharmaceuticals.

Some amount of blood is used for preparation of blood meal for animal feeding or for use as manure. Spray dried blood has its industrial use in leather, cosmetic and detergent industries.

Table 2 : Biochemical and pharmaceutical preparation from blood and their uses

Sl.No.	Item	Yield	Use
1.	Histidine & histidine monohydrochloride	1.4% from RBC	Control of allergic disorders, cordio-vascular and gastro intestinal disorders.
2.	Leucine	5% from RBC	In biological research
3.	Phenyl alanine	2% from RBC	Essential amino acid
4.	Lysine	1.2-1.5% from RBC	Essential amino acid
5.	Haemin	0.35-0.45% crude haemin from blood	For colouring of canned meat and has several biochemical properties.
6.	Protophyrine	-	Mainly in research
7.	Oxyhaemoglobin	-	A starting material for most work on chemistry of haemoglobin and its derivatives
8.	Prothrombin	-	In research in clinical haematology and clinical medicine.
9.	Thrombin	-	Applied as a dry powder or in combination with glucose or sterile saline to control capillary or other surgical bleeding.
10.	Fibrinogen	-	In clinical haematology and veterinary therapeutics
11.	Fibrin	-	In neurosurgery, tooth extraction, plastic surgery, treatment of burns
12.	Haemoglobin concentrate	-	As haematinic mixture for treating anaemia and related cases.

Hide and Skin

Hide/Skin is the most economically important animal by-product and is the major foreign exchange earner in the Animal Husbandry sector. At the slaughterhouse level almost all the hides and skins are collected on the same day and then sent to tanneries. In case of non-availability of tannery in the vicinity, they are processed either by dry or wet salting and then sent to the tannery in lots of few days collection. In large animals, slaughtered stock contribute to about 25% of hides and skin while fallen animals contribute 75% whereas the trend is reverse in case of small animals where slaughter stock contribute to 75% and fallen animals account for 25% of the raw materials for the tanneries. Skins obtained from slaughtered animals are of superior quality compared to that of fallen animals. The recovered hides from fallen large animals are preserved by salting and sun drying before being sent to the tanneries. Skin of small animals slaughtered in the remote villages during different social festivals and family celebrations also find their way to the tanneries through middlemen operating at village level. Still substantial percentage of hide and skin is not recovered and goes waste which amounts Rs.700 million annually.

Table 3: Production of Hides and skins in India during 1998

S.No.	Species	In million pieces	In million Sq. ft.	% share in total
1.	Cattle Hides	25.16	503.2	30.54

2.	Buffalo Hides	21.74	543.5	32.98
3.	Goat skins	88.02	440.1	26.71
4.	Sheep skins	32.17	169.9	9.77
Total			1647.7	100.0

Hides and skins are converted into leathers, then utilized for manufacturing product like footwear, leather goods and garments. During 1996-97, India's exports of leather and leather products was worth Rs.57780 million which accounted for 7% of the total foreign exchange earnings.

Intestines

Intestines of cattle, buffalo, sheep and goat have market as sausage casings. The small intestines are the most widely used raw material for making casings. Besides the small intestines, the large intestines of hog, the weasands (oesophagus) and urinary bladder of cattle and hog, the hog stomach and the beef and hog bungs are also used for processing various types of casings. The steps involved in casing preparation are : collection of healthy raw material, pulling, stripping, fermentation, sliming, scrapping, cleaning and washing and preservation/packing. The casings are inspected and graded before being marketed either in domestic market or in overseas market.

Sheep and goat intestines are also utilized for preparation of catgut, sports guts and musical strings. Both serosa and submucosa layers of intestines are being used for this purpose.

Bones

Bones are obtained in two forms viz. green bones, recovered

from freshly slaughtered stock and desert bones obtained from fallen animals and other sources where they are exposed to decay due to the natural saprophytic activity of microbes in the environment. Based on the animal population and slaughter data, a conservative estimate shows that India produces about 10 lakhs (1 million) metric tones of green bones from buffalo and cattle as meat from these two species are sold mostly as boneless meat. In case of small ruminants and pigs the bones are sold along with muscle except in case of processing ham and bacon from pork. Deodorization of bones is carried out by removing all fat, adhering meat, tendons and blood to the bones by simply heating the crushed bones in water up to a temperature of 60°C for 6 to 10 hours followed by sun/open air drying. Green bones are generally used for extraction of soluble bone protein, edible gelatin etc. whereas desert bones are used either as bone meal for stock feed or for extraction of di calcium phosphate etc. used as fertilizer and/or manufacture of glue.

Besides preparing bone meal or carcass meal, bones are also processed to produce technical fat (tallow), glue and gelatin. There are a good number of factories in and around Mumbai and Kolkata for manufacture of gelatin. These factories, apart from bone, also use hide trimmings, horn, hooves etc.

Bile

Ox bile has been used for medicinal purpose as substitute for human bile in secretory deficiency. Bile acids are useful in correcting indigestion, constipation and biliary tract diseases. Cholic acid, an important constituent of bile is the starting material for the manufacture of cortisones, the life saving drug. Bile acids, cholesterol, others steroids and choline are also being used in the confectionary industry to promote the blooming of chocolates. Bile has been used in different bacteriological media as a selective ingredient. Moreover, bile is an excellent cleaning agent for slaughter house floors, walls and equipments.

On an average 4 gall bladders from large animals viz. cattle and buffalo yield 1 litre of liquid bile. Almost all the bile from small animal goes waste, however, buffalo and cattle bile is being collected in some large slaughter houses for pharmaceutical use.

Glands

In India gland collection and processing is practiced in the large abattoirs where animals are slaughtered in thousands per day and the pharmaceutical companies are located nearby.

Neat's Foot Oil

Other minor by-products such as horns, hooves, hair and bristles are also being recovered and used economically. Hooves are good source of neat's foot oil, a pale yellow oil used for lubrication of delicate machineries at higher altitudes. Neat's foot oil is extracted from the spongy tissue underneath the hooves covering the phalanges of cattle and buffalo. Oil is extracted with moist heat under pressure. The oil obtained is fractioned into three fractions based on their solidification properties. First fraction is used by tanning industry. Second and third fraction

having a solidification temperature of 40°C and below are used for lubrication of sophisticated instruments, watches, aircrafts etc.

Hairs & Bristles

Bristles and hairs obtained from country pigs are collected and sent to bristle dressing unit for further processing. Tail hairs from cattle and buffalo are used by brush industry and earlobe hairs of cattle are used for fine artist brush.

Technologies for by-product processing

Fallen carcass, condemned meat, offals and inedible offals are converted into meat meal or carcass meal and technical grade fat by rendering process. The technical fat is further purified for different purpose.

Rendering

For the preparation of meat-cum-bone meal or carcass meal the process used is the thermal treatment which in other words called rendering or sterilization which commonly denotes two types of processing.

Wet Rendering

In this process meat chunks or bones are cooked with direct steam using vertical cookers at a pressure of 40-60 psi for 4-6 hours. The resulting fat and stick water are separated and the slush of cooked meat and bones are dried and ground to obtain meal.

Dry Rendering

The dry renderer is a horizontal steam jacketed vessel (batch type) equipped with a set of agitators mounted on a horizontal shaft that runs completely through the vessel at its center. Dry rendering is used to eliminate unwanted moisture from the raw material without the loss of nutrients. The meat is cooked in its own fluid. Here, no steam is allowed to pass into the cooking vessel, but steam is allowed into the outer jacket only. The processing temperature ranges between 120-130°C for 3 to 6 hours depending on the capacity of the cooker and the type of raw material to be processed.

Open kettle Rendering

A traditional inexpensive process suitable for rural area where one fallen animal can be processed at a time. The offals and chopped carcass material are loaded into a container which is turned on a turn is mounted at a convenient height over a brick oven usually heated with firewood. During cooking process the material is agitated constantly with a wooden pole. After cooking is over the material is cooled and fat is drained off in a separate container. Cooked mass is dried in the sun.

Autolytic fermentation and Ensiling

Processing of inedible by-products along with intestinal contents can be done by autolytic fermentation method. The materials are minced, adjusted to acidic pH with certain organic acids (eg. formic acid) and held at a suitable temperature

facilitate autolysis by the action of its own enzymes till a thick clear liquid is obtained which can be used for feeding pigs. Sometimes it may be dried by blending with cereals and brans and used as an ingredient in poultry rations. Offals from poultry processing plants are suitable for processing by using this technique.

Silage making of agro-by-products is a proven technology for conservation forages. The same principle is applied for processing of inedible slaughter house by-products. Rumen contents, blood, feathers, poultry litter, ruminant excreta and swine excreta etc. can be suitably processed by this technique.

Protein hydrolysates and isolates

Development of new technologies for processing of collagen based inedible by-products to very high value added end products is a recent concept. During carcass cutting operation and during the processing of hides and skins huge quantity of trimmings and shavings are produced, which can be used as raw material for production of collagen by liming, deharing, mincing and drying. The collagen obtained from such waste has multiple utilities at industrial level for production of glue, gelatin, fertilizer, synthetic leather, animal feed, pet food and in addition to its use in medical field as haemostat and bio-implant.

Preparation of Blood protein isolate

Blood protein are prepared for general use in the food industry and dry protein isolates are best suited for that purpose. These protein isolates contain more than 90% protein.

Ready-to-eat foods from animal by-products

Attempts have been made to develop snack type products using goat stomach and pork rind. Koil Raja et al. (1995) developed ready-to-eat snacks using rumen musculature of goat

by the process of controlled dehydration followed by deep fat frying. Similarly, Agnihotri et al. (1995) developed ready-to-eat crisp snack from goat stomach (rumen, reticulum, omasum and abomasum) by the process of pickling, pressure cooking, drying and deep fat frying of cleaned stomach pieces. Padda and Rao (1984) developed two food snacks (fried pork rind and minced fried pork rind) from pig skin with high protein content and good to very good sensory quality.

Constraints and suggestion

Constraints hindering the development of by-products industries in India include organizational lacunae, lack of awareness by both public and government agencies, financial and technological problems as well as non-availability of sufficient raw material due to very scattered slaughter of animals all over the country. To overcome this problem, adoption of two-tier technology is suggested for utilization of animal by-products in which at first stage the raw materials are to be conserved at the place of their availability by simple, cheap and yet efficient technology and the conserved raw material later to be transported and gathered at a central location where they can be processed into value added end product to make the process an economically viable.

Rate of recovery as well as utilization of inedible by-products is far from satisfactory which is mainly due to lack of infra-structural facilities in the slaughter-houses. Therefore, for better collection and efficient utilization of by-products there is an urgent need to modernize all the large, medium and small slaughter houses in the country. People engaged in slaughter and dressing of animals should be imparted proper training in the collection and better utilization of by-products which has a good overseas market (Table 6).

Table 6: Export of Animal By-products from India

	1994-95		1995-96		1996-97	
	Quantity	Value	Quantity	Value	Quantity	Value
Bristles & Hair	378	53	171	50	165	54
Guts & Casings	335	771	333	850	446	1227
Bone products	371176	7458	42173	8315	43153	12474
Horn & Hoof	6867	763	8714	1139	8054	1121
Bile, Gall stones etc.	0.4	698	172	879	370	855
Leather & Leather products	-	354145	-	407281	-	386555

Quantity : Tonnes Value : Rs in lakhs Source: Kondaiah, 1998

Proper utilization of by-product will help to enhance the sanitary conditions in and around the slaughter houses and will also help to reduce the pollution of the environment which is justifiably a big issue in recent years. All the people associated directly or indirectly with this industry have a definite role to play to improve the existing conditions and to contribute to the development of meat industry as a whole.

References

- Agnihotri, M.K., Pal, U.K. and Rao, S.B.N. (1995). Development of crisp snack from goat stomach. *J. Appl. Anim. Res.* 7: 177-181.
Koil Raja, A., Krishnan, K.R. and Shanmugam, A.M. (1995). Studies

on preparation of snack type meat food from rumen musculature of goat. In: *Prospects of Production, processing and Marketing of Goat Meat*. Rekib, A., Agnihotri, M.K., Pal, U.K., and Hari Shankar (eds.), ISSGPU, Avikanagar. Pp. 33-34.

Mandal, P.K. (1996). *Isolation, Evaluation and Utilization of Globin & Serum Protein Isolates from Buffalo Blood in Food*. Ph.D. Thesis, IVRI, Izatnagar.

Mandal, P.K., Rao, V.K., Kowale, B.N., Pal, U.K. (1999). Utilization of slaughter house blood in human food. *J.Fd. Sci. Technol.* 36: 91-105.

Padda, G.S. and Rao, V.K. (1984). Development of food snacks from pork rind. *J. Fd. Sci. & Technol.* 21:184-185.