

Research Journal of Pharmaceutical, Biological and Chemical Sciences

A Study on the Avian Meat Processing and the Environment.

B Asokumar*.

SSN School of Management, SSN College of Engineering, Kalavakkam, Chennai-603110

ABSTRACT

India is the fifth largest producer of poultry meat which constitutes 95% of total avian meat processed in the Globe. It contributes to the food & Nutrient security to a significant extent. Requirements of the amino acids from animal source is largely met through poultry in India. This research paper has focus on Broiler segment of the poultry industry. The organized and scientific method of broiler slaughtering and processing constitute just 7%. The demand for broiler meat is catered by unorganized slaughtering and vending operations. The enforcement of existing regulations to monitor the hygiene and environmental pollution during slaughtering and disposal of bio wastes are inadequate. Solid bio wastes from poultry processing across the country harbor the pathological sources for Epidemics, unacceptable public hygienic conditions and affect the quality of life. As a stake holder, the public are exposed to such environmental pollutants from unregulated processing through air and water. By adopting proper processing methods, the wastes can be converted in to wealth and add value to the economy besides making the environment clean. This paper identifies causal factors such as pollutants, review of regulatory measures and remedial measures suggested by World Health Organisation, International Food Policy Research Institute, Food and Agriculture Organisation, International Standards committees and various research scholars by extensive review of literature. The discussions with breeders, integrators, wholesalers, retailers and health administrators form the base on which recommendations are made to make the Processing and marketing activity to add value in the value chain and enhance the quality of life on this planet earth.

Keywords: Meat Processing, Avians, Environment, Bio wastes, Broiler farming, International meat processing standards.

**Corresponding author*

Email: asokumarb@ssn.edu.in

INTRODUCTION

Poultry is one of the fastest growing segments of the agricultural sector in India today. The growth is facilitated by a combination of factors - growth in per capita income, a growing urban population and fall in poultry prices. The poultry industry has recorded growth of 5% per annum globally compared to 3% and 1.3% recorded by pork and beef (FAO,2006a). India is the fifth largest producer of table eggs in the world.

Compared to the growth of egg production at 4-6% per annum, the broiler industry grows at 8-10% per annum. Against the recommended per capita consumption of 180 eggs and 10.8 kgs of poultry meat by National Advisory committee, the current consumption stands at 36 eggs and 0.85 Kg of meat. According to Poultry development council of India, more than 100 million people are employed in this industry. It accounts for about 3 % of the total GNP and 10 % of the total GNP attributed to livestock products.

Poultry farming has two distinctive types of production.

1. LAYERS: The birds which are grown for 18 months which start laying table eggs from 22nd week of age and lays around 300 eggs in case of well - bred strains.
2. BROILERS: The birds which are grown for a period of 8 weeks for table meat purpose. The birds are procured by the wholesale and retail poultry meat processors for further processing.

This paper concentrates on the broiler industry only. Within the broiler industry, it focuses on the 90% of the market which is unorganized in processing and marketing.

Broiler Production

During the year 2016, broiler production was 4.2 million tons and it is about 8% more than 2015. 80 percent of total chicken meat production is with unorganized sector. Broiler farming is concentrated in Tamil Nadu, Andhra Pradesh, Maharashtra, Karnataka, Punjab and Haryana states. The poultry meat is classified into Frozen, chilled and fresh meat. About 90% Indian Consumers prefer fresh poultry meat. According to industry sources, Frozen and chilled meat have a market share of about ten percent of total consumption. (Joshua et al 2015).

During the last ten years, about 70% of broiler production has been by integrating with contract farmers (also called integrators), concentrated in southern and western parts of India. The remaining are smaller backyard operations. Integrators own all the hatcheries, feed mills, and logistic facilities, and contract with multiple smaller farmers. Some integrators also provide credit, extension services, and veterinary medicine. At the end of the production cycle, the live birds are marketed by middle man/ to wholesaler, eventually arriving at the live bird wet market for further processing and sale.

For the last five years, chicken meat prices have increased marginally, due to higher feed prices and other costs (see Figure 1 below). Also, the prices of meat from other sources like beef and Pork and the seafood have increased much more than poultry meat and it is one of the reasons for surge in the demand.

Table 1: Overview of the Poultry Processing Operation and generation of by products

Stage 1	Delivery of the birds in Vans/Trucks	Manure, Mortalities
Stage 2	Stunning and Slaughter	Blood, Wastewater
Stage 3	De feathering	Feathers ,Waste Water
Stage 4	Evisceration	Offal / Viscera, Manure and Waste Water
Stage 5	Trimming and Carcass Washing	Fat and Meat Trimmings Waste Water
Stage 6	Boning	Meat Trimmings and Waste Water

(Source: Arvanitoyannis and Ladas,2008)

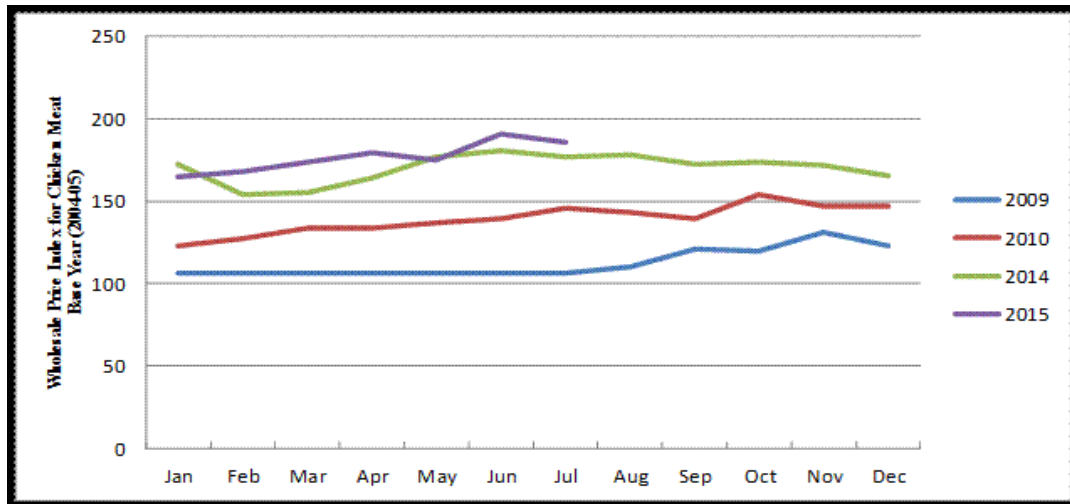


Figure 1: India Chicken Meat Prices Rise (Source: The Ministry of Commerce and Industry, The Government of India)

Importance of the study

Marketing as a discipline has evolved over a period of time with the objective of welfare of the society as a whole and is concerned about all the stakeholders. While meeting the expectations of the customers, the processors can look at the value addition by making use of the process wastes. The value addition is possible by the shift from commodity outlook to poultry processing system in a holistic manner. These stated developments need to be aligned to fulfill varied expectations of the stake holders which include the general public in terms of desirable environment to live in.

In this context, the poultry processing and marketing is looked into in this study. With 90% of processing of the poultry birds in the unorganized sector across the country and without any specific regulation on the location for processing, the results are:

- Unhygienic products are provided to the end users which is harmful for consumption.
- Adoption of improper methods of slaughtering
- Undesirable means of disposal of wastes
- Foregoing the opportunity of creation of value added products from the by-products & wastes
- Pollution by process outputs like solid & water wastes.

The above aspects warrant us to examine the issues at the poultry processing and marketing based on research in various disciplines like Abattoir management, meat processing, Standards stipulated by Food and Agriculture Organisation (FAO), International Finance Corporation (IFC), United States Development Agency (USDA) and various other research institutions to understand the causal factors, likely impact, the best practices, by product utilization and waste disposal mechanisms which would enhance the quality of life of mankind.

Current practices on Processing, marketing and waste disposal

Consumers for the poultry meat is distributed all over the country. The broiler birds once attain the body weight of around 1.8 Kgs to 2.3 Kgs they are moved from the farms to various markets in the country which includes small town and metros as well by caged vans and trucks. At the outlet, based on the requirements of the consumers (by weight, dressed meat with or without skin). After weighing, the jugular veins are cut (Normally sufficient time is not allowed to drain out the blood) and the birds are then dipped in the scald tank of hot water to loosen the feathers. If the birds are preferred with skin, then feathers are removed manually, otherwise the skin is peeled off. The head is then removed and evisceration is done to remove the intestines and internal organs. The carcasses are then washed using potable water. The birds may

then be dressed and prepared as oven ready birds; cut into portions and packaged for supermarkets or delivered to customers.

The conventional methods of processing and delivering a product- poultry meat threatens the well-being of the society in view of epidemics generated from the solid waste being let into the public sewage system or in open drainage.

Solid and water waste consists of the following pollutants.

The poultry fecal matter, carcasses and feathers adversely through the bad odour in the vicinity as a result of a number of chemical compounds, including ammonia, volatile organic compounds and hydrogen sulphide, (Kolominskas et al.,2002). Improper disposal of poultry carcasses can contribute to water problems in areas with high water table. They also contaminate the soil, ground water and surface water (Freedman and Fleming,2003).The quantum of water used in poultry processing is very high like any other food processing industry(IEEP, 2005).Water usage in poultry processing including slaughtering for evisceration, cleaning and washing operations ranges between 6 and 30 cubic meters per tone of the product which is roughly 3kgs of water per kg of meat(EU,2003).Waste water thus disposed reduce the dissolved oxygen in water in the water bodies leads to death and mineralization of algae and affect the aquatic life leading to death (Veerheijen, et al., 1996)

The process wastage generated has high level of Biological Oxygen Demand (BOD) as well as the Chemical Oxygen demand (COD), due to the presence of organic material such as blood, flesh, fat and excreta. The waste water consists of high levels nitrogen, phosphorous, chlorine and pathogens like *Salmonella Sp* and *Campylobacter Sp*.(World Bank,2007).This is confirmed by an experimental study to reiterate about the existence of about 100 different types of pathogens in contaminated feathers, feet and intestinal contents (Arvanitoyannis and Ladas,2008). The Table 2 gives the numerical values of what has been stated above during the studies conducted at different time periods. Typical values for waste water produced during processing are 6.8Kgf of BOD per ton of live weight killed and 3.5Kg suspended solids per ton (de Haan et al., 1997). Parasites such as *Salmonella sp*, *Staphylococcus sp*, *Clostridium sp* *Cryptosporidium Sp* and *Giardia Sp*) will remain in the environment for a longer period(Bowman et al., 2000).

Table 2: Characteristics of Abattoir waste showing chemical oxygen demand (COD) of waste water, biological oxygen demand (BOD), total suspended solids (TSS), Volatile suspended solids (VSS) and total phosphorous (P)

Source	COD(mgL ⁻¹)	BOD ₅ (mgL ⁻¹)	TSS(mgL ⁻¹)	VSS(mgL ⁻¹)	Total P(mgL ⁻¹)
Study 2002	2000-6200	1300-2300	850-6300	660-5250	15-40
Study 2003	5800	2200-9800	2400-9400	-	-
Study 2003	4000	1730	2580	1960	171
Study 2005	3980-7120	2030-4200	285-2660	-	54-92

(Source: Arvanitoyannis and Ladas,2008)

Table 3: Volume of production of rendered proteins in Canada and USA in 2010

Type of rendered protein product	Pounds	%
Ruminant meat and bone meal	2853257	30.9
Poultry by-product meal	1744176	18.9
Non-ruminant mammalian meat and bone meal	1580518	17.3
Mixed ruminant/non-ruminant meat and bone meal	1403261	15.2
Feather meal	673147	7.3
Other proteins	491209	5.3
Ruminant blood meal	240150	2.6
Non ruminant mammalian blood meal	234162	2.5
Total	9219879	100 %

(Source: Darine et al,2011)

Having had an understanding about the processing practices and the by products produced, likely impact on nature and mankind, let us try to look at the possibility of converting these challenges in to opportunities for creation of value.

In view of the population, distribution of the population by consumption of poultry meat across the country, locations of production centers (Farms) and prevailing processing and marketing systems across the country, lack of or inadequate regulatory measures for unorganized processing and disposal mechanisms for wastes & by products, identified problems will not undergo any significant change in the short and medium range of the future.

To give an idea about the size of the waste and by products industry, the results of the survey conducted in North America is provided in Table 3.

The Process of looking at the possibility of adding value to the wastes and by products are provided with the following classifications:

- Waste Water Treatment
- Solid waste Treatment (Edible and Inedible by-Product treatment)

Waste Water Treatment

As mentioned earlier, the waste water in poultry processing contains high content of organic matter from protein, fat and microorganisms. When they are drained in to the municipal sewage system, the pathogens are being carried till the point of evacuation or treatment. Hence it is better to treat the same as much as possible before letting them in to the public sewage system.

The stages involved in such an activity are:

- Preliminary treatment (Screening of meat pieces , Feathers)
- Primary sedimentation
- Secondary treatment (Biological Oxidation)
- Secondary sedimentation
- Tertiary treatment (Filtration)
- Disinfection (Chlorination)
- Sludge Dewatering

Given the nature of the scale of operations of an individual poultry processor, it may not be viable to invest and carry out all the above activities. In metros and Tier 1 cities, where the market is situated in a designated place, a common facility can be created by the municipal corporation. (Eg. Crawford market at Mumbai, Russel market at Bangalore etc).

In smaller towns and the processing cum marketing outlets, solid and water waste collection system should be in place. As it involves capital expenditure, operational costs and local regulations, we need to look at the social cost Vs benefit instead of economic feasibility alone.

The recommendations given by the International Finance Corporation (IFC 2007) are:

- Proper sanitation measures for cleaning the transporting vehicles to maintain hygiene. Collection of solid and liquid wastes at this stage is suggested.
- Use of concrete grids and mechanical filters for preventing organic wastes with water
- Use of dripping trays to collect blood so that it is not mixed with water and debris collection system can collect the blood in an exclusive tank.
- Usage of steam for scalding which would reduce the requirement of water significantly.
- Dripping of water by the birds removed from the scalding tank can be recycled in to scalding tank.

- Collection tray for visceral wastes during the evisceration including prevention of rupture of the intestine.
- Use Coagulation and flocculation material to remove colloids from the waste water.
- The water thus free from solid wastes and blood can be sent for ground water harvesting at the outlets

Solid Waste Treatment

Animal and poultry waste management centre, at North Carolina State University, North Carolina, USA, is engaged in conversion of wastes to valuable products and the work being supported by various organizations, agencies, companies etc. (Anon 1995). The intensive and large scale production of food animals and the animal products has generated an enormous disposal problem for the animal industry. Most of the process wastes can be converted in to useful resources.

According to Hardy and Hardy(1949), feathers can be classified in as:

- Saddle feathers-Long and narrow, vaned feathers from the saddle and back of the rooster
- Hard Feathers-Stiff quills, heavy vanes and a very small amount of fluff
- Half fluff-Vaned feathers with fluff along the lower half of the quill
- Three quarters-Vaned feathers in the lower three quarters of quill
- Fluff-Body feathers with firm shafts bearing only fluff or soft part of the feather
- Plumules-small feathers, soft shafts bearing only pluff
- Downs- Feathers without a shaft, composed of only a tuft or pluff

Based on the chemical to be extracted and the purpose like making beds decide the type of feathers to be processed. The pharmaceutical grade Niacin, Thiamine, Riboflavin, Calcium, Phosphorous and silicon can be extracted and they have immense market value.

By making use of thermophilic digestors in the absence of air can convert animal manure in to energy sources like methane as reported by Shih(1993). The methane thus produced cuts down the energy cost at the site for boiling water and generate steam used for processing.

Properties of a feather degrading bacterium, *Bacillus icheniformis*, can ferment and convert feathers to feather lysate, a digestible protein used in the formulation of animal feed. It is a good source of essential amino acid required by pet animals and the absorption rate is high.

Composite compost units or community composting units with. Bawalkar's Institute of Vermiculture at Pune has established the feasibility of converting the solid waste except feathers in to Vermi compost using earthworms which is being marketed for vineyards, floriculture and for organic farming. The decomposition and conversion in to vermin compost takes about 15 days.

The visceral wastes, head and bones are used in pet food for canines, fur bearing animals and in feeding fish and dogs. Meat and bone meal is highly recommended and it reduces the requirement of corn and soya for animal feed production. (Deydier et al.2005)

The rendering industry (the process of converting animal wastes into stable, value added materials) produces hundreds of useful products which are divided in to edible & inedible oils, Chemicals, meat meals, bone meals, etc. The concerns expressed above require appropriate social responsibility initiatives from the major Industry players like Venkateshwara Hatcheries/ Venky's India, Pioneer Hatcheries, the Broiler association of India, Poultry development council etc. in creating and maintaining vermi compost yards, Community incinerators, Solid and liquid waste collection systems in collaboration with the municipal administration. Also training the processors in handling bio wastes with appropriate scientifically proven sanitation measures would ensure value creation from wastes besides protecting the environment.

Managerial Implications

Organisations have got the responsibility to protect the interests of the stake holders. In the poultry meat processing industry, the solid and liquid wastes are generated. They are harmful to the environment. Certain measures like community incinerators for destroying the pathogens, vermiculture for converting solid waste in to vermin compost for enriching soil in the farms, using the feathers for extracting amino acids and solar panelled mobile processing stations as designed by Michigan university are certain remedial measures recommended.

CONCLUSION

In the growing Indian economy with great concern about food security and malnutrition, Poultry industry plays a major role in meeting the nutritional requirements. This study focussed on Poultry meat processing and marketing activities. The farms rearing broiler birds are located away from consumption centres. The processing of the bird and marketing of the meat take place in the same place / outlet and it contributes to an extent of 90% of the total market and the balance by chilled and frozen meat. The outlets are not regulated sufficiently for slaughtering, processing and disposing the wastes properly. This results in unhygienic end product to the customer, improper disposal of wastes creating stress in the atmosphere and the public health is threatened.

The study reviewed the nature of pollutants, their impact on the environment based on literature survey and identified possible avenues to enhance the value addition by converting wastes in to economically viable products. Also, the various guidelines laid out for safeguarding health through proper environment by various organisations are provided.

REFERENCES

- [1] Arvanitoyannis IS (2008) Waste management for the food industries. Academic Press an imprint of Elsevier, London, p 1100
- [2] Bowman, A., Mueller, K. & Smith, M.2000. Increased animal waste production from concentrated animal feeding operations.Potential implications for public and environmental health.Occasional Paper series, No,2. Omaha, USA, Nebraska Centre for Rural Health Research.
- [3] Darine S, Christophe V, Gholamreza D (2010) Production and feather utilization – a review. *PoultSci* 72(9):1617–1620
- [4] De Haan, C.H., Steinfeld, H. & Blackburn, H,1997. Livestock and the environment:finding a balance, Suffolk, UK, WRENmedia.
- [5] Deydier, E.,R. Guilet, and P.Sharrock. 2003 Beneficial use of meat and bone meal combustionresidue: an efficient low cost material to remove lead from aqueous effluent. *Journal of Hazardous Materials*,101:55
- [6] EU. 2003. Integrated pollution prevention and control: reference document on best available techniques for intensive rearing of poultry and pigs. Brussels, European Commission
- [7] FAO, 2006a World agriculture towards 2030/2050 interim report, Rome.
- [8] Freedman, R. & Fleming, R.2003 Water quality impacts of burying livestock mortalities. Paper presented to the Livestock Mortality Recycling Project Steering Committee, Ridgetown, Canada, Ridgetown College/ University of Guleph. (Available at [http:// www. ridgetownc.on.ca/ research/ documents/ fleming_ carcassburial.pdf](http://www.ridgetownc.on.ca/research/documents/fleming_carcassburial.pdf))
- [9] IEEP.2005. The environmental impacts of trade liberalisation and potential flanking measures. Stage 1 of a Report to DEFRA, London, Institute for Environmental Policy.
- [10] IFC (International Finance Corporation), Environment, Health and Safety (EHS) guidelines for waste Management facilities, April,30,2007.
- [11] Joshua Emmanuel Lagos and Vijay Intodia, "Poultry and Poultry Products Annual 2015-India"- GAIN Report number IN 5124, Report of Global Agricultural Information Network (2015). of USDA Foreign Agricultural Service
- [12] Kolominskas,C., Bawden,K. &Ormerod,R. 2002,Strategies to reduce odour emissionsfrom meat chicken processing. In *Proceedings 2002 Poultry information Exchange*,pp27-39 available at <http://www.fsaconsulting.net/pdfs/PIX%20Odour.pdf>



- [13] Kondaiah N, Anjaneyulu ASR, Lakshmanan V (1993) Incorporation functional properties of beef lung protein concentrates. Meat and chicken by-products in mutton nuggets. J Food Sci Technol 30
- [14] Shih JCH (1993) Recent development in poultry waste digestion 84(4):315–322
- [15] Verheijen, L.A.H.M., Wiersema, D. Hulshoff Pol, L.W. & De Wit, J.1996Management of Waste from animal product processing. Wageningen, the Netherlands,International Agricultural Centre.(availableat<http://www.fao.org/WAIRDOCS/LEAD/X6114E/X6114E00.HTM>)
- [16] World Bank. 2007. Environmental, health and safety guidelines for poultry processing, Washington DC.