The Disposal of Light and Heavy Spent Fowl in Canada

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Final copy: September 12, 2005

Spent Fowl Use in Canada

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1.0 Introduction

Spent fowl are considered to be egg-laying chickens that have completed a laying cycle, and that are being culled as a flock in order to accommodate for a younger and more productive flock. Heavy spent fowl are broiler breeder hens and roosters, who go to market at about 60 weeks of age, and light spent fowl are laying hens and roosters, such as leghorns, that go to market at about 60 weeks of age. In broiler breeder flocks, the stocking rate of males to females is about 8 – 10%; during the laying cycle, the flock is 'spiked' with younger males that replace some of the older and less reproductive males. In a commercial egg laying flock, there are no males, but in a Leghorn hatching egg flock, the stocking rate of males is similar to that of broiler breeders.

The dominant issue with spent fowl is that producers have few methods of disposing of their flocks, not all of which are economically beneficial. The price for spent fowl for slaughter is low, and often not feasible when transportation costs are considered. Therefore, producers are concerned with improved measures of flock disposal, and especially methods that will increase income from the use of the spent birds.

Processors may be interested in the volume and value of the spent fowl produced each year as a potential source of income as well. Knowing the supply of birds and what nutrients are provided by each bird in terms of protein, fat, feathers and blood can aid them in making processing decisions for feasibility, profitability, and the type of further processed products that would be marketable to consumers.

Society is becoming increasingly aware of animal production and welfare issues, as well as the impact of agriculture on the environment. It would be pro-active of the industry to find a welfare and environmentally-conscious solution for flock disposal before it becomes a major issue to the public, and decreases the value of poultry products.

This paper is a summary of the current status of the spent fowl populations in Alberta and Canada. The number of spent fowl present every year, the carcass composition of spent fowl, what producers are currently doing to dispose of their flocks, and other methods for flock disposal will all discussed, in an effort to provide insight into the way the spent fowl industry stands now, and where it could be going in favour of producers and processors.

2.0 Spent fowl in Alberta and Canada

In 2004, Agriculture and Agri-Food Canada reported the live price to producers for spent birds above 2.0 kg (heavy fowl) as follows: Vancouver, $0.45/kg; Toronto, $0.41/kg for January and February; Montreal, $0.35/kg; and Halifax, $0.43/kg. Live price to producer in Edmonton, Regina, Winnipeg, Toronto (after February), Moncton, Charlottetown, and St. John's was reported at $0.00. The average processor price for birds above 2.0 kg (heavy fowl) was $0.00 (AAFC website).

In Alberta, there are about 169 table egg producers, with an average total flock size of 9944 birds (total number of birds on-farm, not necessarily of the same age) (personal communication, Dr. D. Korver). About 277 spent flocks (table egg and broiler hatching egg birds) are disposed of every year, which represents about 1,608,562 birds (personal communication, S. Gal).

There are about 572,776 heavy spent fowl in Alberta every year (personal communication, N. Robinson). There are 35 producers that hold quota for broiler breeders in the province (personal communication, N. Robinson), so the average quota held by each producer is about 16,365 units. Each unit of quota represents one bird.

In Canada, there are approximately 1,100 table egg operations, with an average of 17,800 hens per farm. There are about 20.2 million commercial laying hens in the country (personal communication, Dr. D. Korver; CEMA website).

Broiler breeder operations number about 300 in Canada, and average flock size is 15,000 hens (CBHEMA). This equates to approximately 4.5 million broiler breeder spent fowl per year.

In 2004, AAFC reported that over 24 million mature birds (over 25 million kg) were slaughtered by canners across the country, and another 4 million mature chickens (over 11 million kg) were slaughtered at other registered stations (AAFC website). That represents an aggregate of over 28 million head (36 million kg) mature chickens slaughtered in Canada last year; of this, the 4 million of the spent fowl slaughtered were imported (note: in 2004, Canada did not export live spent fowl) (AAFC website). Based on the weight of birds killed divided by the number of birds slaughtered, it appears that

canners are mainly slaughtering light spent fowl, whereas the other registered stations are primarily slaughtering heavy spent fowl.

These numbers show that there is a significant supply of spent fowl every year, both in Alberta and across Canada. A unified effort by producers and processors to establish a system for the reliable supply and slaughter of spent fowl, as well as increased marketing of spent fowl products to the public, could result in increased profitability of spent fowl on the whole.

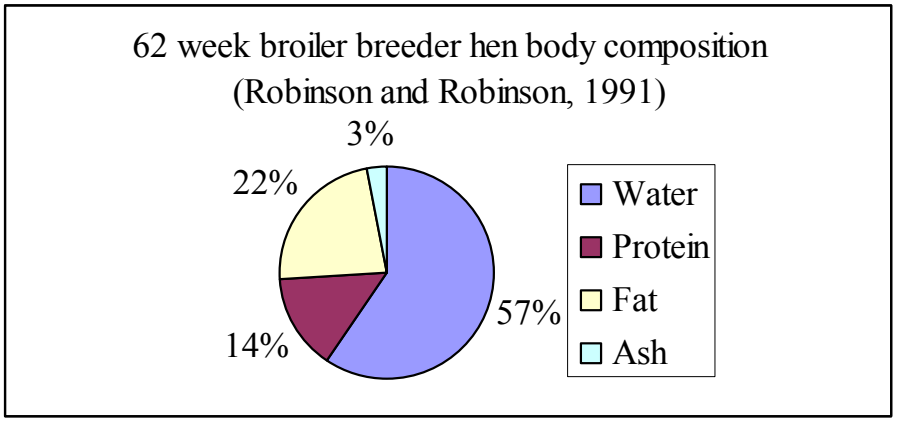
3.0 Carcass composition of spent fowl

Protein, fat and ash

Broiler breeders

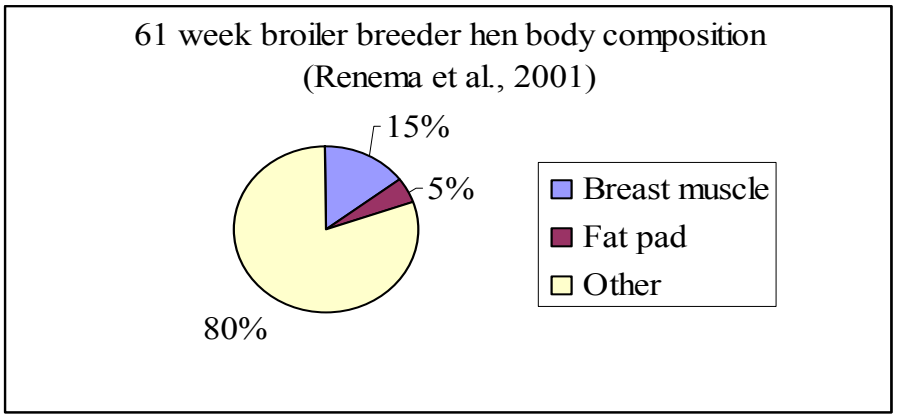
In a study by Robinson and Robinson (1991), broiler breeder hens at 62 weeks of age had an average body weight of 3587 g ± 84. Of this weight, 2045 ± 61 g (57%) was water, 508 ± 12 g (14%) was protein, 795 ± 54 g (22%) was fat, and 102 ± 4 g (3%) was ash (mineral content). See Figure #1.

Figure #1



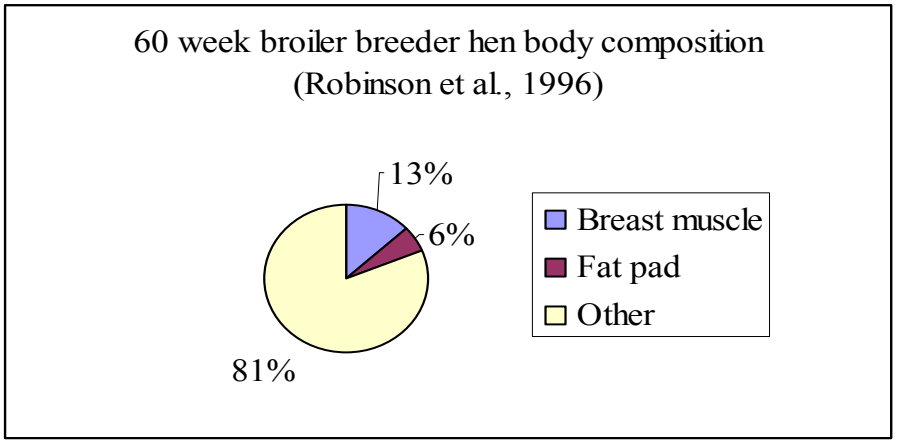
Other parameters were measured by Renema et al. (2001), in an experiment that included non-eviscerated carcass traits of 61 week-old broiler breeder hens. Raised on a standard growth curve, the hens had an average body weight of 3724 g. Fifteen percent of the body weight was breast muscle weight, and five percent of the body weight consisted of the abdominal fat pad. See Figure #2.

Figure #2



Another study by Robinson et al. (1996) examined the carcass characteristics of broiler breeder hens differing in age at point of photostimulation. At 60 weeks of age, the hens photostimulated at 120, 130, 140, 150 and 160 days of age all had similar breast muscle and abdominal fat pad weights as a percentage of body weight; breast muscle comprised between 13 and 13.3 percent of body weight, and fat pad was 6.2 – 6.4% of body weight. See. Figure #3.

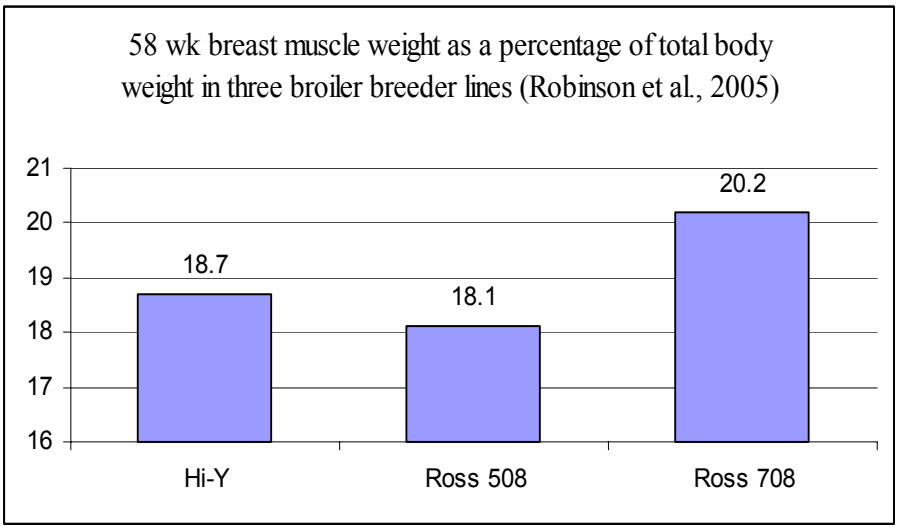
Figure #3



A recent study by Robinson, Zuidhof and Renema (2005) compared three different genetic lines raised on different programs of feed allocation and age at photostimulation. The carcass composition results were compared between genetic lines (Hubbard Hi-Y, Ross 508, and Ross 708), using the means for genetic grouping across feed allocation and age a photostimulation means. Final body weights were similar for the three lines: 3784g Hi-Y, 3823g Ross 508, 3834g Ross 708. However, breast muscle

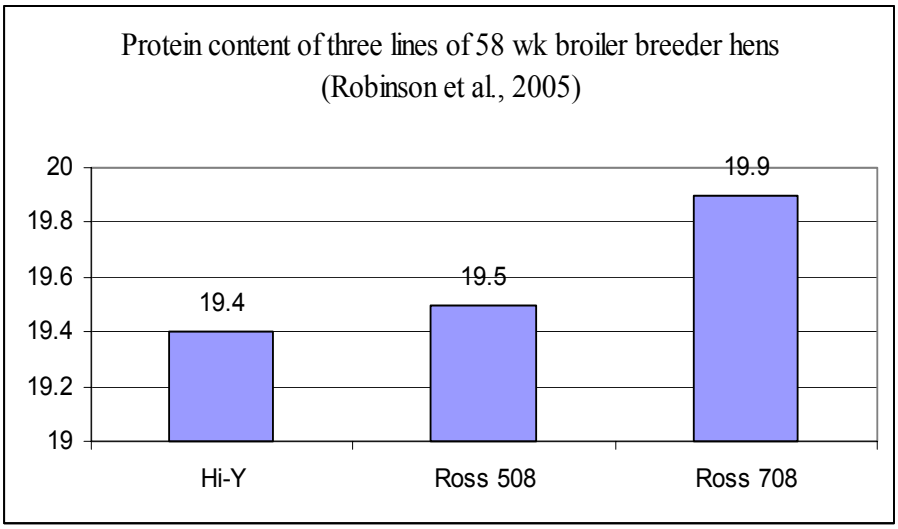
weight, as a percentage of total body weight, differed between the strains; Hi-Y was 18.7%, Ross 508 was 18.1% and Ross 708 was 20.2% (see Figure #4).

Figure #4



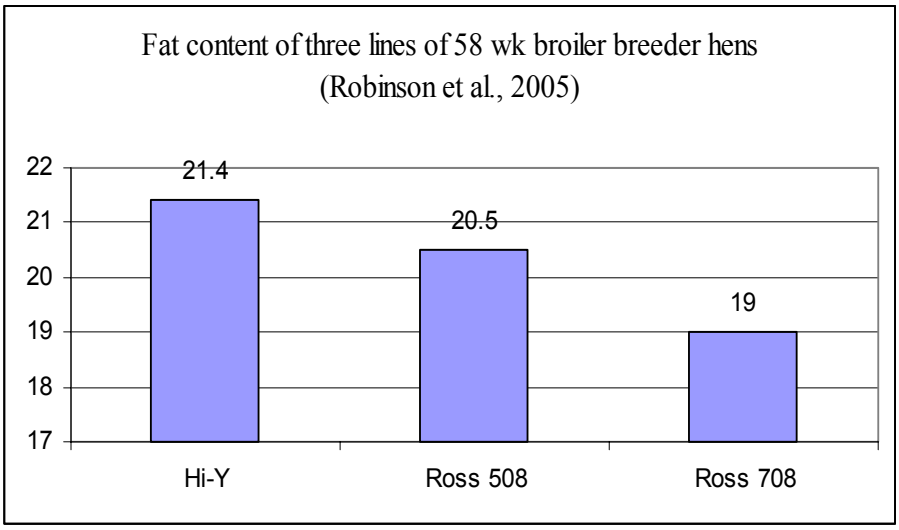
Total protein content of the carcasses was as follows: Hi-Y was 19.4%, Ross 508 was 19.5%, and Ross 708 was 19.9% (see Figure #5).

Figure #5



Total fat content of the carcasses of the strains was: Hi-Y 21.4%, Ross 508 20.5%, and Ross 708 19.0% (see Figure #6).

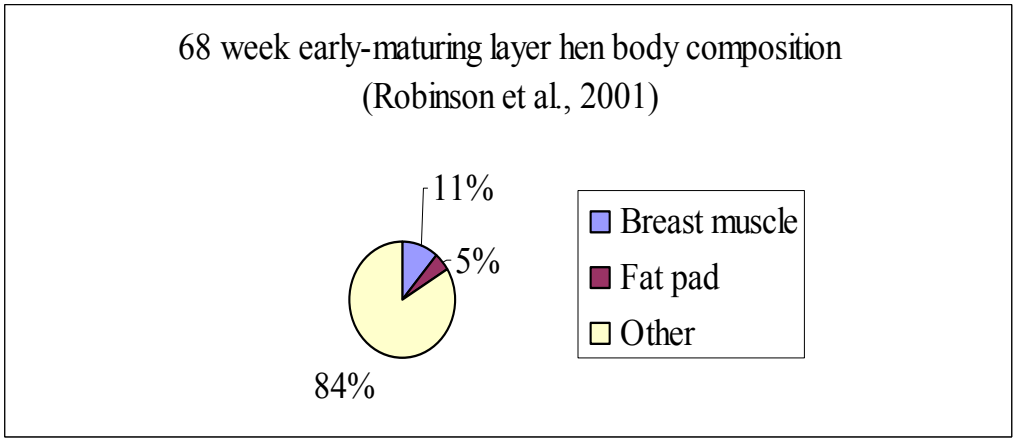
Figure #6



Laying hens

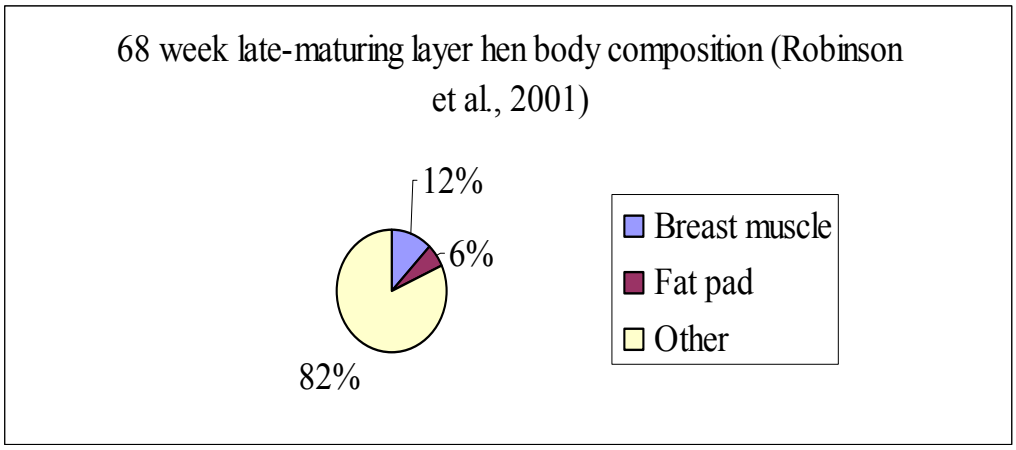
Robinson et al. (2001) conducted a study which included the carcass analysis of an early and a late strain of Single Comb White Leghorn (SCWL) hens at 68 weeks of age. The early maturing strain (Babcock B300) had a body weight average of 1690 g, of which 11.17% constituted breast muscle weight, and 4.58% was abdominal fat pad weight (see Figure #7).

Figure #7



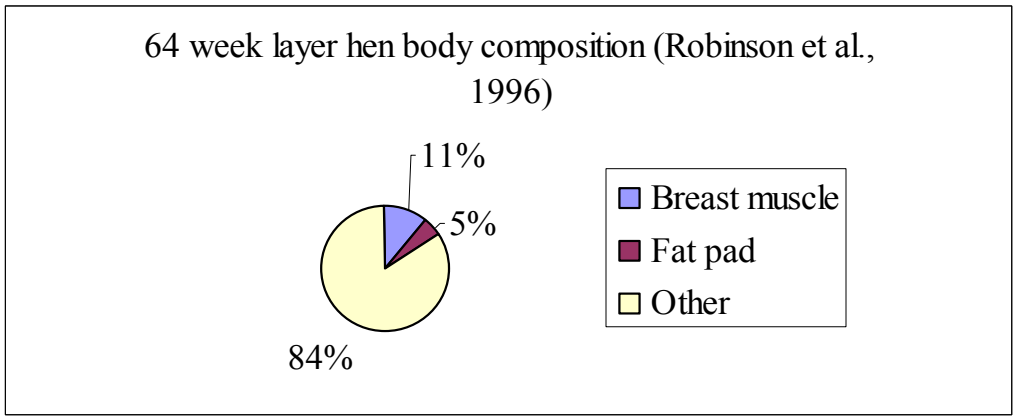
The late maturing strain (Shaver White) had an average body weight of 1994 g, where 11.81 % was breast muscle and 5.84 % was abdominal fat pad (see Figure #8).

Figure #8



A second study by Robinson et al. (1996) examined the effect of age at photostimulation (16, 18 or 20 weeks of age) on reproductive efficiency and carcass characteristics of SCWL hens. Carcass characteristics measured at 64 weeks of age showed that breast muscle and abdominal fat pad weights were similar across the three photostimulation ages; breast muscle comprised 10.7% of body weight, and fat pad represented between 4.6 and 5.0% of body weight (see Figure #9).

Figure #9



Feather Weight

Broiler breeder hens at 26 weeks of age, with an average dead weight of 2877 g, had an average feather weight of 61 g, which is about 2% of body weight (personal communication, Dr. F. Robinson). Leghorn hens at 60 weeks, with an average dead weight of 2165 g, had an average feather weight of 63 g, about 3% of body weight

(personal communication, Erica Holm). As hens age, the weight of her feathers may decrease since she continues to lose feathers. This holds especially true for broiler breeder hens as they lose feathers to males; therefore, though the broiler breeders used for this calculation aren't at maturity, it is not likely that the feather weight at the end of the laying cycle will be significantly different.

Feather meal is a processing byproduct that can be used as a dietary supplement. The yield of feather meal is about 22% of the initial feather weight (personal communication, R. Wilkinson). Therefore, from the 20.2 million light hens in Canada in 2004, with a total feather weight of 1,273,408 kg, 280,150 kg of feather meal could be produced. At about $310 per tonne (personal communication, R. Wilkinson), the value of all this feather meal is $86,846. Another $18,853 would be generated from the 60,815 kg of feather meal produced by the 4.5 million mature broiler breeders in Canada in 2004, with a total feather weight of 276,435 kg. The total revenue from feather meal alone, assuming all mature chickens are slaughtered, and all their feathers are used for feather meal, would be $105,699.

Blood Weight

Blood volume in chickens is approximately 6.5% of body weight at maturity (Bell and Freeman, 1971). A mature chicken of 2.5 kg would have 240 mL of blood, with a weight of about 162.5 g.

If the same average body weight of the light spent fowl is used as above (2165.18 g), the approximate weight of blood in these birds will be 141g. Mature broiler breeders, assuming 8% of the spent fowl population is roosters, and final body weights are about 3.5 kg for females and 4.8 kg for males, will have an average flock weight of 3.6 kg, yielding about 234 g of blood.

If the total amount of blood from 20.2 million layer hens (2,848,200 kg) and 4.5 million broiler breeders (1,053,000 kg) is made into blood meal, which yields at about 10% of the initial weight, the total amount of blood meal would be 390,120 kg. At $550 per tonne, the revenue from the total blood meal of all mature chickens in Canada would be $214,566.

Being aware of the composition of and potential income that can be generated from spent fowl carcasses allows for producers and processors to make decisions about the feasibility of processing the carcasses for further marketing. Specialized processing systems, taking into consideration the larger or smaller size of spent fowl, could be utilized in order to take advantage of the nutrients that are on the carcasses.

4.0 Current methods of flock disposal

Every year, producers have to find some way to dispose of their flocks in an economically viable and animal welfare-friendly manner. Slaughter does not always present a financially beneficial option, so producers have turned to other methods to dispose of their flocks.

Broiler breeders

In Alberta, 35 producers own broiler breeder quota. Eggs are shipped to Lilydale, Maple Leaf, Sunrise, and two independent hatcheries. There are 572,776 quota units available in Alberta. One bird is equivalent to one unit of quota; therefore, there are roughly 572,776 mature fowl available for slaughter in Alberta each year (personal communication with N. Robinson, AHEP).

In total, Lilydale processes about 600,000 birds per year, about half of which are from Saskatchewan and British Colombia (personal communication, J. VanKampen).

Maple Leaf processing no longer processes heavy fowl, following the termination of Maple Leaf's turkey processing practices; therefore, broiler breeder producers that ship eggs to Maple Leaf now ship their flocks to Northern Goose Processors in Teulon, Manitoba. However, when there is not sufficient spent fowl for a full truckload, small numbers of broiler breeders are at times processed by Lakeland Poultry Processors in St. Paul, Alberta.

Northern Goose processes half a million heavy spent fowl per year, from Alberta, Saskatchewan, and Manitoba (personal communication, D. Salkeld). The birds are shipped to Manitoba, and producers are not charged for the transport of their birds. At

Northern Goose, the birds are slaughtered and eviscerated, and the whole carcasses are then shipped to Ontario for further processing (personal communication, D. Salkeld).

Broiler breeder producers in Alberta are currently receiving $0.16 per kg live weight for their spent flocks. Catching the birds costs about $0.25 per bird (for Maple Leaf producers), plus mileage and equipment costs (personal communication, Pieter Rietveld).

Laying hens

Currently, 61.77% of the light spent fowl in Alberta (993,609 birds) are disposed of by the producer, using axe/knife, electric stunner, gas, cervical dislocation, and other methods. The majority of the resulting carcasses are used for compost, are buried, are used by the producers (in the kitchen or as dog food), or inspected and sold.

The other 38.23% of birds are slaughtered at Northern Alberta Processors. Producers are charged for the mobile gassing unit to go out to the farm and kill the flock with gas. The carcasses are then brought back to Northern Alberta Processors where they are rendered whole. After tallow separation and water recycling, the resulting dry and ground poultry meal is sold for $550 per tonne (personal communication, R. Wilkinson).

An interesting story in eastern Canada is that of Maple Lodge Farms in Ontario. Maple Lodge processes approximately 1.4 million birds per week, roughly half of which are light fowl purchased from Ontario and the United States. The birds are killed and processed at Maple Lodge; legs are exported, breasts are made into the several kinds of chicken roasts that Maple Lodge markets, and the carcass is processed for mechanically separated meat. The chicken roasts from Maple Lodge include Black Forest chicken and chicken salami, as well as Caribbean, Cajun, and Fajita roasts. The mechanically separated meat (MSM) that is taken off the processed carcasses it put through a grinder and then pushed through a screen to rid it of bones and bone fragments (the bones are then used for bone meal); the resulting meat is used in the widely consumed chicken wieners from Maple Lodge. The spent fowl products from Maple Lodge appeal to the consumer who values low-fat and nutritious meal, which are easily prepared but also tasty.

There are, however, problems with using light fowl. These include the relatively high number of dead-on-arrival (DOA) birds that are counted when a flock arrives at the processing facility; because of the small nature of the laying hens, and their relatively depleted state at the end of the laying cycle, they are not able to cope well with the stress and physical strain of transport. Also, the small size, low feather cover, and lack of fat on the birds can result in even higher transport mortality during the winter. The size of the birds can be a hindrance on the kill line as well, as the feathers are difficult to remove, and the small carcass size can be difficult to handle. If these problems are addressed with a long-term stance, it may be possible to minimize these issues and create a stable market for light spent fowl.

5.0 Other disposal options

Current methods of carcass disposal in Alberta include burying, composting, and using the carcasses for personal consumption. Other potential methods of carcass disposal include biodigestion, incineration, and rendering. When selecting a disposal method for a flock, the income to the producer must be considered, but consideration must also be given to the environmental and biological ramifications of disposing considerable amounts of organic matter (Blake and Donald, 1992). Potential methods of carcass disposal discussed here include biodigestion, burial, incineration, composting, and rendering.

Biodigestion – Kuehn, 2004.

Method:

Large machines – biodigesters or tissue digesters – can be utilized to turn carcasses into an aqueous solution of nutrients. The carcasses are put in a large tub, a caustic alkaline solution, and the mixture is heated. What results is an aqueous solution of peptides and amino acids, sugars, soaps, and bones. The solution is sterile and can be disposed of through a sterile sewer to a sewage treatment plant. Bones are reduced to ash. Any solids are biologically inactive, and can be disposed of in landfills. Colorado

State University utilizes the solution as fertilizer and as an additive to compost piles due to the high nitrogen content.

The advantages of the biodigester are as follows:

- Pathogens, including prions, are destroyed during the process.
- One machine can digest the equivalent of a 1,200 lbs cow in six hours.
- Operating cost of the machine is approximately one – third that of an incinerator.
- Biodigesters can be built into mobile units for response to disease outbreaks requiring emergency culling at specific locations. Biosecurity is therefore enhanced by removing the necessity of transporting the infected animals.
- More environmentally–considerate than incinerators, in that there are no fumes or ash produced during the process. This is also a benefit to the health of the workers that dispose of the carcasses.
- Easy disposal of resulting substances, and potentially beneficial uses of the products, such as fertilizer or in compost.
- One machine, even at minimum capacity of one cow, can process many chickens at one time.

The disadvantages of the biodigesters are:

- High initial cost to purchase one of the machines – anywhere upwards of $25,000 US.
- Requirement of somewhere to put the machine, and the trained staff to operate the machine and surrounding facilities.

Likely, if a biodigester was purchased and operated in a community fashion, and was located centrally or available in a mobile unit, many producers could share the equipment, and all dispose of their flocks quickly and in an environmentally-friendly fashion. They could also reap the financial benefits of using the product solution as fertilizer or a compost additive.

Burial – Blake and Donald, 1992.

Method:

There are several methods of burial. They include:

- A trench is dug on-farm, and is then filled with carcasses and progressively covered with dirt.
- Burial pits, lined with concrete, dirt, or wood. Pre-cast septic tanks that are open on the bottom can also be put into the pits in order to facilitate anaerobic decomposition.
    - Heating, agitating, or cutting up the carcasses decreases the amount of time it takes for the carcasses to decompose.
- Sanitary landfills.
- Inverted feedbins.

Advantages of burial include:

- Convenience – disposal is on-farm and done by the producer, which can save money.
- The cost of burial and incineration are similar.

Disadvantages of burial include:

- Potential safety hazard to workers and farm inhabitants.
- Predators digging up the carcasses (this is a biosecurity hazard, as well as an annoyance and a hazard to people).
- Trenches are subject to weather conditions – wet or frozen dirt is difficult to use in covering the carcasses.
- Anaerobic decomposition in burial pits produces an unpleasant odour.
- Burial pits need to be located above ground water, and in soil that is suitable for filtration of effluent, especially for pits with open bottoms.
- Burial pits with open bottoms can leave residues that are present for several years after the pit is emptied.

Incineration – Blake and Donald, 1992

Method:

Incineration of carcasses involves burning the spent fowl carcasses. Complete incineration of carcasses is recommended. Simply putting a flammable material on a pile of carcasses and lighting them on fire does not constitute proper disposal. The best method of incineration is to use a commercial incinerator, which utilizes gas or oil,

timers, and fittings on the smock-stacks that ensure complete emitted gasses are completely combusted, and reduce the resulting odour.

Advantages of incineration:

- Biologically safe – accumulation and disposal of waste products can occur at the same rate. Waste product disposal is relatively easy.
- Products of incineration do not attract other animals to the site, which improves biosecurity.

Disadvantages of incineration:

- Time – consuming process.
- Relatively expensive, being that either a unit must be installed on farm or carcasses/live birds must be transported to facilities with a unit.
- Pollution by particulate matter.
- Maintenance and replacement costs of equipment can be high.

Composting – Blake and Donald, 1992

Method:

Microorganisms are used to decompose the organic matter on carcasses. Fresh carcasses are put in the first of two bins, with layers of litter or straw between layers of carcasses for aeration. Layers of manure are also included, and each layer of carcasses is watered to keep them moist. While carcasses provide nitrogen for microbial growth, the litter or straw provides carbon. Carbon to nitrogen ratio should be 23:1, and moisture content should remain around 55%. Microbial decomposition of the carcasses causes a temperatures increase in the bin, which helps in killing microorganisms withouth hear tolerance, and any other organisms present (worms, flies). Upon cooling, the material can be moved to the second of two bins. This aerates the material. Another heating and cooling cycle will occur, and then the material can be distributed on land or stored for later distribution.

Advantages of composting:

- The product of carcass composting can be used as a fertilizer on soil.
- Economic.
- Biologically safe.

- Can be done on-farm.

Disadvantages of composting as a disposal method:

- If done incorrectly or incompletely, some pathogens can survive the heating cycles, and will persist in the material.

Rendering – Blake and Donald, 1992

Method:

Carcasses can be frozen, treated with acids, or fermented before transport to the rendering facility. This is done to keep the carcasses in a steady state before rendering, when carcasses have to be kept on-farm between collection intervals. Refrigeration essentially freezes the carcasses. Acid treatment uses mineral or organic acids as preservatives, which preserve the nutrients in the carcass, but kill pathogenic bacteria. These methods have no effect on the quality of the protein meal after rendering. Fermentation is similar to the ensiling process – pre – ground carcasses are mixed with a carbohydrate source in known amounts and lactic fermentation proceeds. Fermentation causes the pH of the mixture to decrease, down to below 4.5, which kills pathogenic organisms but stabilizes the decomposition of the carcasses. Fermentation and rendering used in combination can result in a very high quality protein meal product.

Extrusion uses high temperatures for a short time to cook, sterilize, dehydrate, and stabilize carcasses. The result is protein meal, which is easily digestible, and potentially of high quality (depending on the quality of the input material). Other feed ingredients can be added to the carcasses prior to extrusion. The process of extrusion removes microbiological species from the material, so that the meal is no longer a potential source for spread of pathogens.

Advantages of rendering:

- The by-product is protein meal, which has commercial value.
- Using fermentation, carcasses can be stored on-farm in a steady state until the next pick-up, or until there are enough carcasses to make transportation costs feasible.

Disadvantages of rendering as a disposal method:

- Potential biosecurity threat from the collection of carcasses and movement of carcasses off-farm to a common rendering facility.
- Additional transportation cost for removing the birds from the farm and taking them to a facility. This cost is even higher if carcasses are treated (frozen, fermented or treated with acid) before being collected for rendering.
- Acid treatment of carcasses can be expensive, and there are safety concerns with transporting acids to and from farms, and storage of the acid.
- Fermentation requires the carcasses to be ground before mixed with a carbohydrate source and packed. This would require the appropriate machinery, and time.

6.0 Conclusion

There is potential for increased use and value of spent fowl in the table egg and broiler hatching egg industries. If a long-term and creative stance is adopted by producers and processors with regards to the disposal of spent fowl flocks, it is possible that producers, processors, and consumers, can all benefit. Using a variety of methods, available on a range of scales, allows management flexibility such that many participants can benefit from more economically beneficial disposal of spent fowl flocks.

7.0 Acknowledgements

I would like to sincerely thank everyone that contributed to this project, from processors to producers to professors. I genuinely appreciate your help.

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Personal Communications

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John VanKampen, Lilydale Processors. (780) 377 – 4812.

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