Managing evisceration line

The processing plant is a critical link in the farm to fork product chain. Aside from speed, precise killing, cutting and cleaning, product quality and safety have become a critical part of the process. What are the main issues for efficient management of the evisceration line?

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The intestinal pack should not be damaged during evisceration.

The evisceration process is a sequence of operations that affect the chicken carcasses in different ways and can also affect quality, yield and hygiene to various extents. To protect these important operational parameters from possible interferences, the managerial actions towards the evisceration process must begin when the birds still are in the growing houses and finish only after the carcasses go through the final washer, the last phase of operation of the evisceration line. The first of that managerial set of actions to be put into motion is an efficient feed-withdrawal program.

Line start-up

At the plant, the coops or containers are unloaded and the live birds are then hung, stunned and bled. As the efficacy of the hanging operation interferes to some extent with the efficacy of the evisceration line performance, the success of the operation does not depend solely on informing the hanging team as to "what to do" but also on fulfilling certain pre-requisites that can be grouped into three categories: ergonomics, maintenance and methodology.

With regard to live hanging ergonomics, it is first necessary to position the hanging station carefully to comfortably accommodate those responsible for doing the job and then to integrate the workers and the equipment by coordinating the workers, the conveyor belt and the killing line configuration. Additionally, one must ensure worker safety by reducing the environment aggressiveness with the installation of a dust exhauster, distributing safety equipment and educating workers on the importance of their use.

Maintenance department personnel must attempt to implement a 100%-effective feet de-hanger, as the return of shackled feet to the hanging line may force workers either to deviate from their primary task to remove feet from the shackles, or hang live birds on the feet. The shackles on the line must be fully levelled and their openings compatible with the live birds' shank sizes. Experience has taught it is virtually impossible to secure a perfect interaction between shackles and feet, mostly due to the natural non-uniformity of the birds. One must have an opening gauging that simultaneously assures secure holding of the birds and their uniform positioning onto the bottom of the shackles.

Working methods also add value to the operation. For this reason the company should establish a hanging method that best suits its requirements, focusing not only on the quality of the carcasses, but also on the hanging teams' comfort, to secure consistency over the work shifts. The chosen method must be treated formally and inserted into the quality assurance system's documentation. This method must be the reference used to train new employees and to retrain veterans as well. Its insertion in the working routine must be re-evaluated by means of daily work supervision and periodic auditing of the entire process.

Bleeding asymmetric birds

Birds can be bled either manually or automatically. Of the two methods, manual bleeding has the most flexibility to deal with the natural asymmetry of the birds properly, thereby ensuring consistency in the placement, depth and extension of the bleeding cut, with minimal or no impact on the physical integrity of the trachea, oesophagus and spinal cord.

Following the bleeding, the carcasses are scalded, plucked and then moved from the bleeding line to the evisceration line, either manually or automatically. While manual transfer of the carcasses requires personnel training and supervision, automatic transfer requires an integrated supervision of the different steps of the processing chain: the live hanging, the continuous synchrony between the killing and evisceration lines and the performance of the on-line hock cutter.

It is quite common to have a head-puller located just before the evisceration line, a requirement seldom seen in manual evisceration lines. The role of the head puller consists of removing the heads along with the tracheas and crops, parts that, being connected with the lungs and the proventriculus respectively, are responsible for the "spring effect" on the viscera package during evisceration. This spring effect may cause the total or partial viscera package to fall back into the abdominal cavity, requiring manual re-exhibition right after the eviscerator to present it properly for sanitary inspection and giblets collection employees along the line. For this reason, securing the physical integrity of the tracheas and oesophagus during the bleeding is helpful in removing them intact from almost 100% of the carcasses, upgrading the evisceration process and eliminating the need for additional and costly labour. The efficacy in the removal of those two parts of the entrails seems to be affected not only by the bleeding method but also by an unclear interaction between the method

The yellowish colour at the back clearly shows leakage of the gall bladder, causing downgrading.

Contamination of the carcasses by visible faecal material is a major defect and must be avoided.

and the stunning parameters. Experience shows that the incidence of crops extracted intact from the carcasses is higher for birds stunned at 12 volts and killed automatically than for those stunned at 50 or 200 volts and killed manually.

The venter

The venter is responsible for cutting off and displacing the totality of the vents and Fabricius bursas from the carcasses. The equipment consists of a set of rotating axis in whose ends are coupled circular knives, which hold a guide-pin in their centres. During operation, the axis descends onto the abdomens while the guide-pins, longer than the knives, penetrate into the vent to correct the rectal portion of the intestine, just before the rotating movement of the knives cut off the vents. During this sequence, while the axes start ascending back to their rest position, the guide-pins remove and displace the vents, ending the operational cycle.

The guide-pins can displace the vents by either mechanical traction or vacuum applied to the intestinal wall. When vacuum is used, the difference between internal and external pressure may cause leakage of small amounts of faecal material that drop onto the back and contaminate the carcass when the vent is displaced. The contamination of the carcass by visible faecal material is a major defect under sanitary inspection criteria in several countries and must be avoided for its economic and operational impact on the process. Thus, one expects a quick response from department supervision to detect the extent and frequency of faecal leakage problems and to suggest and implement either preventive or corrective measures.

The efficacy, hygiene and yield of the venting operation depend on meeting a few requirements.

- The operation efficacy depends on the correct transfer from the bleeding to the evisceration line
- Synchronized adaptation between the carcasses and the venter's modules
- Sharpening and periodic replacement of the rotating knives
- Proper displacement of the cut vents and on proper washing of the guide-pins and knives with water nozzles

The level of the process' hygiene depends on an effective feed-withdrawal program, effective supervision to reduce the risk of intestine tearing; thorough cleaning of the knives and guide-pins with water nozzles and on the availability of a shower to remove sporadic faecal material staining the backs.

To maximize operational yield, the diameter of the knives must match the size of the carcasses; the knives must be replaced frequently to ensure proper and clean vent cutting and must be sharpened well to preserve the recommended angle and width of the cutting edge.

Opening of the abdomen

Moving arms fitted with flat blades at their ends open the carcass abdomen. The carcasses, uniformly positioned down into the shackle, must enter the machine in a synchronised manner to adapt smoothly to the modules, and helped by adjustable guides and correct machine height.

To get a clean opening, the ends of the movable arms must insert freely but not deeply into the abdominal cavity through the opening left by the removal of the vents. Once inside, they move ahead towards the breast, while the blades slit the skin, either vertically or transversally. No matter what the cut shape, the work performed by the arm-blade set must result in a wide opening in the abdomen to facilitate the viscera package removal and boost carcass cooling, internal cleaning and water uptake, without nicking the keel bone end. The flat blades are key parts of the process and the cutting edge must be replaced frequently and be free of fat or skin scraps. As the viscera package volume changes in accordance with the time birds stay off-feed, the feed-withdrawal program may make intestines more or less susceptible to the abdominal opening operation. Consequently, the process must be supervised continuously and carefully to guarantee the guide bars, the pressure on the carcasses and the machine height are precisely adjusted in accordance with birds' size. These are operational cares that together can contribute to reducing the risk of intestine tearing and carcass contamination.

Smooth evisceration

Among the various operations in the line, the evisceration is the most delicate one because of the precision required and the susceptibility of the viscera to physical damage. Helped by the guide bars and adjustable machine height, the carcasses must plug into the eviscerator smoothly and evenly, allowing the eviscerating spoon to slide down into the abdominal cavity between the keel bone and the viscera package, preserving the viscera from damage, until reaching the neck opening. At this point, the spoon traps the proventriculus and then reverts its movement. During the ascension, the spoon hooks up the lungs attaching them to the viscera package, which is soon exposed and released, thus ending the cycle. To minimize the "spring effect" impact on the process, most of the trachea and crops must have been previously removed along with the heads far back in the line.

Among the various risk situations during the evisceration process, the most prevalent are faecal and bile contamination. During the feed-withdrawal program the birds continue to produce bile that is accumulated in the gall bladder. The longer the time off-feed, the larger the volume of bile produced and accumulated, thus the larger the longitudinal distension of the gall bladder, making it very susceptible to handling. Either during the evisceration or harvesting of the edible giblets its likelihood to damage can increase the incidence of giblet and carcass contamination.

The birds must go off-feed a few hours prior to slaughter to allow the emptying of the digestive tract and intestines. If this period is shortened or an external disturbance affects the birds' behaviour, this process will not be as effective as expected and the birds may present residues of ingesta in their digestive tract or faecal content in their intestines upon arrival at the plant. The contamination of the carcasses by visible ingesta or faecal material is associated to a short feed-withdrawal program of less than eight hours, while the contamination caused by the leakage of intestinal fluid on the carcass is associated with long feed-withdrawal. If birds go off-feed for 13 to 14 hours, the intestinal lining is degraded, leading to a progressive reduction in

intestinal strength and increased susceptibility to breakage and contamination of the carcasses during evisceration.

Clean cropping

No matter how precise the bleeding operation was, the removal of tracheas and crops in the head puller are not complete and require a later inspection of the neck skin by the cropping machine.

The cropping machine is a group of rotating spears equipped with finned heads. When in operation, these rotating spears move down into the abdominal cavity and pass through the entire carcass until the finned head reaches the neck skin, where they then scrape the left tracheas and crops. Descending even further, the spears go beyond the neck to have the crops and tracheas swept off by a rotating brush.

For being an inspection-purpose piece of equipment only, the croppers' effectiveness depends on the amount of crops and tracheas to be removed. Upon entry, the carcasses must be placed on the lowest possible shackle and must accommodate the modules smoothly. The spears' vertical range is determined by matching the machine height and the size of the carcasses. The correct positioning of the cleaning brush improves the washing efficiency of the heads while extending its durability.

The equipment supplied operates within a reasonably broad range of carcass weights. In spite of this, frequent unsuccessful experiences result from modifications in the spears rotating speed, in the spears diameter and in the opening of the fins; all put in place to solve the sporadic presence of excessive residual crops and tracheas in the carcasses after inspection. Before such problems occur, one should first start working far back on the line instead of on the machinery characteristics, a choice that, instead of solving the cause of the problems, just increase them.

For the suppliers of chicken parts for fast-food chains, the cropper is of utmost importance for the quality of the raw material that goes to the cut-up line. Due to the variation in the carcass sizes and in their un-uniform positioning into the modules, the rotation movement of the finned heads may break the carcass' ribs or clavicle during its descent into the cavity. This mal-performance may lead to cuts located in the front part of the carcass and to the insertion of small bone fragments into the breast muscle. To work preventively, carcasses either should be size-selected before entering the evisceration line or, ideally, should not vary much in size. The carcass accommodation to the machine can be smoothed, the spears can have their diameter reduced and fins could be angled in instead of out, alternatives that either alone or combined may reduce the operational damage inside the carcasses, reducing the incidence of the problem.

During their time off-feed, birds get hungry and, as there is no feed available in the feeders, they go looking for it on the floor, which is often contaminated. Some research has demonstrated that birds that eat from the floor are highly contaminated with Salmonella in the crop when arriving at the plant. The *Salmonella* present in the crop can easily spread all over the carcasses during the cropping operation. The crop can be broken, thus contaminating the spears, which, in turn, transfer the microbial load from one carcass to the other. To create an additional barrier against *Salmonella* cross-contamination, it is recommended washing and sanitizing the spears at every cycle and each time the brush washes off the finned heads. Also washing every moveable part of the equipment with high-pressure, chlorinated water is advised.

Considerations

The evisceration line is a set of operations that has a high degree of interdependence and whose total efficacy depends on internal and external variables. This interdependence among the parts, which manifests continuously but in different points of the line, if not properly managed may compromise the product's quality, hygiene and yield and, at the end of the day, the company's bottom-line.

Therefore, it is fundamental that those responsible for managing the department posses a solid managerial and technical knowledge of the process, secure a continuous and goal-driven supervision, act promptly either preventively or correctively, and keep a strong communication and close proximity with the neighbouring de partments.

Lung removal

The eviscerator extracts around 95% of the lungs along with the viscera package while the remaining 5% are left for the lung extractor. In operation, the suction pipe descends into the carcasses and when they are levelled up with the lung cavities, the vacuum is activated, sucking the lungs off. The suction pipe then ascends and leaves the carcass. Before re-starting a new cycle, it is flushed from inside out with tap water to remove residues.

To achieve the desired results it is important to secure proper positioning of the carcasses into the shackles and fine-tune the synchronisation along the line as well as the machine and the vacuum triggering. It is also important to keep in mind that the level of vacuum is a key parameter of the process and that the machines role is inspecting remaining lungs only. This means the eviscerator must previously have done the main part of the job.

Not only is carcass cleanliness important but also its yield.

To avoid the premature vacuum triggering aspirates the kidneys or the abdominal fat leaves, the cycle of the suction pipes must be finely synchronized with that of the carcasses.

The final washer

The final inside/outside washer acts as an ultimate barrier to prevent physical and microbiological contaminants that have adhered to the carcasses being transferred to the cooling line. The final washer is equipped with washing spears whose ends are endowed with washing nozzles. They slide down into the carcass cavity and upon entry turn on the water flush and start the internal cleansing process. Externally high-pressure water nozzles remove residues and contaminants stuck to the outer surface of the carcass.

Washing mechanism principles may vary among equipment manufacturers. In some machines, the washing spears pass through the carcass from the abdominal opening to the neck skin, washing and simultaneously draining the dirty water. In others, the spears descend and wash only the abdominal cavity, providing smaller coverage while favouring the accumulation of dirty water inside the cavity. Finally yet importantly, there is a system that combines the abdominal cavity washing only with a mechanism that tilts the carcass backwards to drain out the dirty water from the cavity at the end of the cycle.

To optimise the washing operation it is advisable to install a hydrometer to help establish the most efficient water *consumption x cleanliness* relationship, to keep the water pressure at the recommended level and to install only water nozzles of adequate configuration for the task.

The final washers are frequently fed by a slave water pipeline that uses a hyper-chlorination level of around 20 ppm. The use of hyper-chlorinated water in some parts of the processing chain other than the chilling line has proven to be an effective measure that reduces by 10 fold the microbial load after the cooling process. To preserve the bactericide properties of the sanitizer it is important to monitor the chlorine levels as well as the water pH. By adding chlorine to the water the pH may increase to high values, which is not recommended. To lower the pH it is advised to add food-grade organic acids or CO_2 to the water.

The benefits of the simultaneous use of final washer/washing cabinet combination, must be measured by the microbiological evaluation of the carcasses, otherwise it just wastes water and sanitizer. On the other hand, the final washer is not the only measure available to protect the cooling line from the dumping of physical and microbiological contaminants. The reduction of the microbial load of *Enterobacteriacea* achieved for carcasses washed in washing cabinets is as high as those for carcasses washed in final washers, making it possible to conclude that final washers are not more efficient in the removal of microorganisms than washing cabinets. h

Note: Literature is available upon request from Fabio Nunes, a poultry processing consultant. Email: fabio.g.nunes@uol.com.br