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Does chicken become healthier? An inventory on the basis of the rates and reasons for condemnation of poultry meat from 2002 to 2017 in German slaughterhouses

Ist das Geflügel gesünder geworden? Eine Bestandsaufnahme auf der Basis der Beanstandungen bei der Geflügelfleischuntersuchung von 2002–2017 in Deutschland

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Summary

This evaluation was designed to review the condemnation rate of poultry meat as well as grossly detectable abnormalities and conditions (GDACs) encountered in German poultry slaughter houses from 2002 to 2017 to determine which findings could indicate retrospective health conditions of live poultry. Modern chicken breeds for fattening are selected especially for fast growing and an optimal feed conversion together with a high proportion of the most valuable breast meat. In contrast, breeds for laying hens are selected for maximal egg production and less muscle volume. However, the unidirectional genetic selection focused to a higher muscle/bone-relation or maximal laying productivity has created (in connection with modern animal husbandry) breeds which are very sensitive for specific diseases and syndromes if their environment, feed and management is imbalanced. The evaluation of German meat inspection data concerning the overall condemnation rate from 2002 to 2006/2017 and GDACs from 2002 to 2017 indicates an almost constant rate both for the condemnation and the GDACs of broilers, laying hens and turkeys. The overall condemnation rate for broiler oscillates between 1 and 2% with falling tendency until 2014 and since then an increase for 2017 to 2.8%. For laying hens the portion of meat condemned amounts for an average rate of approximately 3.6%. The condemnation rate for turkey meat varies between 0.8 and 1.4% with a slight increase of condemnation since 2015. Although GDACs are created for food hygiene purposes, many of them like ascites, dermatitis and leg irritations arise undoubtful from animal health and animal welfare conditions. These findings together with the GDACs like hematoma, bruises, and breast blister were selected to indicate health conditions of live poultry. According to the evaluation of existing meat inspection for the last two decades the overall condemnation rate and most GDACs remained on the same level and could not prove a progress in an enhanced health status of poultry. Although the current scope of meat inspection performance is primarily to safeguard consumer health, a thorough evaluation of suitable findings and performance indicators associated with animal health and welfare would complement future meat inspection outcome.

Keywords: poultry, meat inspection, condemnation rate

Zusammenfassung

Die vorliegende Auswertung dient der Bewertung des Verwurfs von Geflügelfleisch sowie von makroskopisch deutlich hervortretenden Veränderungen und Merkmalen (MVM), die bei der Geflügelfleischuntersuchung von 2002 bis 2017 in Deutschland festgestellt wurden, um daran retrospektiv auf den Gesundheitszustand des lebenden Geflügels zu schließen. Moderne Geflügellinien der Zuchtrichtung Mast sind insbesondere für ein schnelles Wachstum und eine optimale Futterverwertung gezüchtet worden, um einen besonders großen Muskelfleischanteil zu erzielen. Die Zucht für Legehennen konzentriert sich im Gegensatz dazu auf weniger Fleischansatz, dafür aber auf eine optimale Legeleistung. Diese einseitige Selektion hin zu einem höheren Muskel/Kochen-Anteil beziehungsweise einer maximalen Legeleistung führte (zusammen mit den modernen Haltungsbedingungen) auch einer verringerten gesundheitlichen Robustheit, die mit besonderen Erkrankungserscheinungen einhergeht. Bei der Auswertung der in Deutschland gesammelten Fleischuntersuchungsdaten für die Jahre 2002 bis 2017 zeigte sich für Broiler, Legehennen oder Puten ein fast gleichbleibender Stand von Verwürfen und von MVM. Die mittlere Beanstandungsrate für Jungmastgeflügel schwankte zwischen 1 bis 2% und stieg 2017 auf 2,8%. Im Rahmen der Fleischuntersuchung von Legehennen wurden bei der Schlachtung zwischen 2 und 6% des Fleisches (im Durchschnitt 3,6%) verworfen. Die Beanstandungsrate für Putenfleisch betrug 0,8 bis 1,4% mit einem leichten Anstieg der Beanstandungsrate seit 2015. Obwohl MVM aus lebensmittelhygienischer Sicht beanstandet werden, besteht z.B. für Ascites,

Dermatitis und Beinschäden zweifelsfrei ein enger Zusammenhang zur Tiergesundheit und dem Wohlbefinden der Tiere. Diese Befunde sowie als weitere MVM zum Beispiel Hämatome, Verletzungen und Brustblasen wurden als geeignete Parameter gewählt, um retrospektiv auf den Gesundheitszustand des lebenden Geflügels zu schließen. Die Auswertung dieser Befunde für die letzten zwei Jahrzehnte zeigte keinen erhöhten Gesundheitszustand des Geflügels. Während die gegenwärtige Zielsetzung der Geflügelfleischuntersuchung in erster Linie auf den gesundheitlichen Schutz des Konsumenten ausgerichtet ist, kann die zusätzliche Auswertung geeigneter Befunde und Leistungsindikatoren im Zusammenhang mit der Tiergesundheit und dem Wohlbefinden der Tiere einen zusätzlichen Nutzen der Geflügelfleischuntersuchung bieten.

Schlüsselwörter: Geflügel, Fleischuntersuchung, Beanstandungsrate

Introduction

The worldwide meat production has continued to rise in the last four decades from approximately 16 Mio. tonnes in 1977 to 110 Mio. tonnes in 2016 (Bundschuh and Westphal, 2016). Accordingly the German poultry production increased in a steady pace to 1.8 Mio. tonnes in 2015. Broilers by far the largest group of poultry farmed commercially and account currently for more than 70% of poultry meat in Germany. Within all poultry meat consumed per capita in Germany broiler meat shares 2015 the highest percentage (60%) which accounts for 20.1 kg (Beck, 2018). Modern chicken breeds were selected especially for fast growing and an optimal feed conversion rate (which is close to 1.5 kg feed to 1 kg meat) and a high percentage of the most valuable breast meat. Today's commercial fattening breeds like Cobb500®, Cobb700®, Cobb-Sasso®, Ross308® and Ross708® are predominate in the German market (COBB, 2018; Aviagen, 2018). Most breeds are distributed worldwide from companies like Cobb-Vantress and Aviagen.

However the genetic selection to a higher muscle/bone-relation and maximal laying productivity has created also physiological conditions associated for instance with an increase of flock mortality due to cardio-vascular diseases and leg lameness syndrome. Breeding companies are aware of these negative health conditions and tried to include such aspects also in their overall genetic goals. Their efforts are focused on a sound development of the musculoskeletal system to prevent perosis, tibiatorsion, tibia dyschondroplasia including a resistance breeding i.e. against Marek disease and the eradication of mycoplasmosis. In current programs for the breeding of fattening broiler the involved companies guarantee the absence of all vertical transmitted zoonotic agents at least until the grand parents' level (Löhren, 1997). Knowing that their fast growing breeds are sensitive to adverse conditions, breeding companies also recommend practical advice to the farmers for a restricted feeding regime leading to a reduced pace in live weight gain as a measure to minimize the loss of birds. Detailed information for a breed adapted feed consumption and dosage also include a management plan for the environment of the birds to the farmers (Aviagen, 2014; Ross 2018).

Slaughter and control of poultry meat

As a reaction to the increase of poultry meat production in Europe an EU wide meat inspection procedure was introduced for poultry in the 1970s to safeguard the consumer from health risks, to ensure the wholesomeness of poultry meat and to protect poultry from animal diseases. When birds reach the desired weight at the end of the fattening period or at the end of the laying period they are send to slaughter and have to be inspected by a mandatory ante and post mortem inspection. General requirements for meat inspection are laid down by the regulation (EC) No 854/2004 (EU, 2004).

According to the legal requirements, a first examination of a fattening flock on the farm of origin before slaughter takes place by the official authority when birds reach their final or foreseen weight. The aim of this ante mortem inspection on the farm is to generate information in addition to the findings/information given by the farmer and the supervising veterinarian in the familiar setting of the flock. The investigation is performed by a checkup of animals for zoonosis (or suspicion on zoonosis) as well as for abnormal behavior and for signs which may indicate that the meat could be unfit for human consumption. In addition, the control of documents may give information about the possible occurrence of residues of forbidden or banned drugs or substances above maximum residue levels when withdrawal time is still running. The documents available on farm also inform the competent authority about the number and dates of animals placed at the beginning of the fattening period in the barn, the daily losses (separated by animals dead and killed) and the description of litter used. Further criteria to assess the health condition of the birds are the distribution of the animals on the area available in the barn, the feed and water consumption and vaccination and application of drugs. Indispensable for ante mortem inspection is also the assessment of the locomotion, the rate and type of respiration, the constitution/quality of the feathers and possible alteration at the eyes, the quality of the feces and the occurrence of abnormities like ascites (QS, 2012).

On arrival at the slaughterhouse, an obligatory ante-mortem inspection covers a screening to ascertain whether animal welfare rules have been complied with and whether signs of any condition which might adversely affect human or animal health are present (EU, 2004). In addition the food chain information is coming along with the flock to the slaughterhouse to summarize the above mentioned information from the farm of origin.

The following meat inspection is performed after slaughter of birds to identify not only potentially health hazard to consumers but also to protect the consumers from animal diseases, quality aspects and to ensure wholesomeness of the meat. During this process every carcass and its organs are controlled for abnormalities and diseases by routine inspection methods. In general the inspection of poultry is practically divided in several inspection post one after the other. Every post has its special task.

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At the first inspection post the whole carcass (not eviscerated) is inspected from the outside to identify carcasses i.e. with deep dermatitis, ascites and animals which growed too thin. After evisceration at the second inspection post the organs are examined (depending on the slaughter technology either in trays or hanging) and at the third inspection post the internal surface of the eviscerated carcasses are inspected to detect i.e. polyserositis or any contamination. At all inspection posts the light conditions have to be sufficient and at some inspection posts mirrors are installed to improve the visual examination. But unfortunately mirrors are often steamed up or contaminated and therefore not always helpful. A shift of the inspection personnel takes normally 20 minutes before the persons at the inspection posts change their position i.e. from the first to the second post etc. Some slaughterhouses have installed cameras at the first inspection post to identify not only very small carcasses but also discolored ones. In addition to the already mentioned inspection posts a further person is permanently in charge to supervise the hygiene performance of the slaughterline as well as the activities of the "fixed" inspection posts. While the line speed in some premises has reached up to 12.000 birds per hour at slaughter the inspection personnel have only a limited capacity to recognize all abnormalities and relevant findings. To compensate this high line speed at the second and third inspection posts the inspection personnel is doubled. In general poultry meat inspection needs a high competence to recognize abnormalities which are often hidden to a person who has not practiced poultry meat inspection before. Therefore poultry meat inspection is always orientated on key parameters and sensitive for false positive or negative findings (Kölling, 1997). To minimize possible mistakes, findings that are difficult to interprete and to be prepared on a sudden high occurrence of findings the official auxiliaries are in permanent contact with the official veterinarian in charge to discuss uncommon findings whether these might pose a serious health risk.

In contrast to the ante mortem examination of flocks on the farm of origin, findings from meat inspection collected at the slaughterhouse by the competent authority are well documented due to legal requirements and published online on an annual base by the Federal Statistical Office (Anon., 2005, 2006; DESTATIS, 2018). The findings are grossly detectable abnormalities and conditions (GDACs) representing almost a comprehensive picture of the flock health status at the moment of slaughter. Almost all birds introduced in a barn at the beginning of the fattening period reach the desired weight. Visual findings like discoloration of organs, adhesion of membranes and purulent locations can be a sign and indication of ante mortem deficiencies. All findings are the result of possible diseases / health conditions of the flock during their fattening period or their productive time in case of laying hens. Although Huneau-Salüen (2015) and co-workers observed many diseases and deficiencies, which could be detected already at the farm of origin long before meat inspection, the post mortem inspection is not redundant by the ante mortem inspection because no reliable prediction can be given before slaughter about the health condition of flocks at the moment of slaughter. Aberrations in the health of a broiler flock do not always become fully manifest in clinical signs during the short fattening period. However at meat inspection it becomes obvious which kind of disease / health problems have been arisen during fattening period and if infective to which extent these conditions spread in the flock.

Amount of condemned meat and grossly detectable abnormalities and conditions

The data base provided by the Federal Statistical Office includes figures about the total amount of poultry slaughtered as well as the total amount of meat condemned and GDACs (DESTATIS, 2018). Reasons for the overall condemnation rates for broiler, laying hens and turkeys differ due to their various live conditions and environment.

The list of findings in the official statistics includes also some GDACs like technological damage caused by the slaughter equipment which have to be separated from the findings qualified for a feedback to the farm of origin (Weise, 1997). Unfortunately, other relevant findings from the respiratory tract are not documented during meat inspection because of anatomical reasons. Nevertheless this information could be of high interest for a feedback, but they are normally of low interest for food hygiene. Affectations of the skin are of great significance as they are an indicator for systemic illness and because of their relevance as a quality indicator to the consumer. During the fattening period the chicken skin is exposed to the climate in the barn (humidity, noxious gas etc.), the litter, and mutual other maltreatment (Bergmann, 2001). In such cases skin findings are not always leading directly to an etiological diagnosis (contact or deep dermatitis). Haarmann (2006) identifies high numbers of E. coli in superficially degraded skin areas as well as in surrounding but unchanged breast muscle. In addition to a primary and superficially infection the prevalence of these bacteria can be triggered by respiratory diseases or by ascending infections from the intestine. In case of such inflammation live birds show a retarded growth. Ascites, findings at the heart and pericardium are often associated with a higher weight of the liver and in connection with an intensive feeding regime and suboptimal management. Ascites becomes manifest as a collection of fluid in the abdomen of the bird and is often seen with hydropericardium and liver changes. According to a literature review of Langkabel and Fries (2011) ascites appears as a multifactor syndrome in broilers as well as in laying hens and cannot be seen as a distinct disease, triggered by many factors while genetically "handicapped" animals are more often affected. Alterations of the liver seen at meat inspection indicate not only a systemic illness and a challenge for the feed regime but also an economical loss because the liver cannot be market any more. Because of their genetically assigned purpose to egg production and their longer live span laying hens show at slaughter in particular tumors, abscesses and inflammation of the intestine and salpingitis. These findings are recorded more often compared to fattening chicken (Grossklaus, 1979). The reasons for enteritis are manifold and very unspecific due to bacterial, viral, parasitic, toxic and nutritional causes. Enteritis is seen during post-mortem inspection together with emaciation and serious atrophy of the fat around the heart and is often noted while no adipose is visible. Malignant tumors and multiple abscesses of different etiology are more often seen with older birds, which are also predisposed for hematoma, bruises and cicatrices (Grist, 2006). In addition, hematoma and bruises could be related to transport conditions or rough catching circumstances. Diseases and alterations of the joints subsequently lead to lameness and effect therefore not only for the mobility and the wellbeing of the birds. Due to mobility constraints of the birds also the feed intake is affected. If this results in a reduced weight gain, it is a negative economic impact for the farmer. Lameness of chicken is often correlated with

an enhanced growth of young chicken and a high feed supply resulting in a deformation of bones (Knowles et al., 2008; Kestin et al., 1992). In addition to the effects on the feeding regime, Knowles et al. (2008) assigned a reduced ability to walk up to a total walk disorder for certain broiler breeds. Following their observation age, population density and a high portion of darkness in the light regime are responsible for lameness. Koglin (1999) observed for about 10% of broiler in a random sample of 300 carcasses in the slaughter line alterations at the tarsal joints which became manifest in swelling of tendon at their onset together with inflammation of the bursa, bleeding and contact dermatitis in the area of tarsal joints. Not included in the official GDCA list are foot pad damages which are recommended to be listed by Erhard and coworkers (2014) to be recorded not only during meat inspection but also on the farm of origin during ante mortem inspection.

Besides GDACs already mentioned also overall aspects like "generalized disease" (turkey) and "other alteration" (broiler, laying hens) are registered at meat inspection. Not in every case a finding at the line is obvious at first glance and therefore does not necessarily match a given list in the statistic system. In many of such cases systemic findings in carcasses or organs are reason to put a finding in this general category. A frequent use of this category is a signal for a new or still undefined disease condition and should be reason for a cause study to update the provided list of findings.

Material and methods

An overview of meat inspection results given by the German Statistical Office every year was used as the basis for evaluation (DESTATIS, 2018). These data are collected from the respective competent authorities of the German Laender in the slaughterhouses according to a certain scheme which is derived from the current European regulation (EC) No 854/2004 and to fulfill national regulatory requirements.

As the most prominent category in the list the term „unfit carcass and by-products of slaughter" was evaluated for the time period from 2002 to 2016/2017 for broiler, laying hens and turkey. This term includes all meat (including all GDACs) condemned in German poultry slaughterhouses. Although the formal legal basis for poultry meat inspection has changed during 2002–2017 by the introduction of the Regulation (EC) No 854/2004 the data parameter for the most important findings remained constant in the national database because they were derived from the earlier Directive 92/116/EEC (updating Directive 71/118/EEC on health problems affecting trade in fresh poultry meat) (EU, 1971).

Further on the following GDACs were considered:

1. For broiler meat the findings generalized tumors and abscesses, deep dermatitis and bruises/swelling on the breast, ascites, changes in heart and pericardium, alteration in liver and the so called general term "other pathological changes".
2. For laying hens the findings tumors and abscesses, deep dermatitis, ascites, hematoma, bruises and cicatrisation, salpingitis, inflammation of the intestine and the so called general term "other pathological changes".
3. For turkey the findings deep dermatitis, pericarditis, hematoma-bruises-cicatrisation, inflammation of joints, general illness and other findings at liver.

Other GDACs for broiler, laying hens and turkey were also recorded and collected in the statistics but were not included in this assessment because of their variability and missing values during the whole period considered. All numbers for GDAC and also for carcasses in the statistics are given in kilograms.

As a high speed of the slaughter line have also adversely affects to the precision of the data collected the quality of the incoming data is ensured by a variety of measures taken by the Federal Statistical Office, including plausibility checks. In case of missing or implausible data, corrections are made by contacting the responsible veterinary office.

Results

The amount of meat declared unfit for human consumption from broiler, laying hens and turkey slaughtered is correlated to the total amount of poultry delivered to the slaughterhouse. The resulting number represents the portion of meat of a poultry type condemned in Germany every year. In general this portion is roughly between 1 to 2% for broiler meat. The condemnation rate for broiler has decreased from 2002 (1.7%) to 1.2% in 2014 and increased again from that time onwards to 2.8% in 2017. For laying hens the portion of meat declared unfit per year between 2006 and 2016 amounts for approximately 4%. Due to missing data from 2002 to 2004, no calculation executed and based on statistical aspects the total figures for slaughtered hens in 2012 and 2013 were interpolated.The percentage for condemned turkey meat oscillates to hit a low point of approx. 0.8% in 2004 and 2015. Higher condemnation rates were observed in 2008 (1.4%) while the average rate accounts for approx.1 to 1.2% (Figure 1).

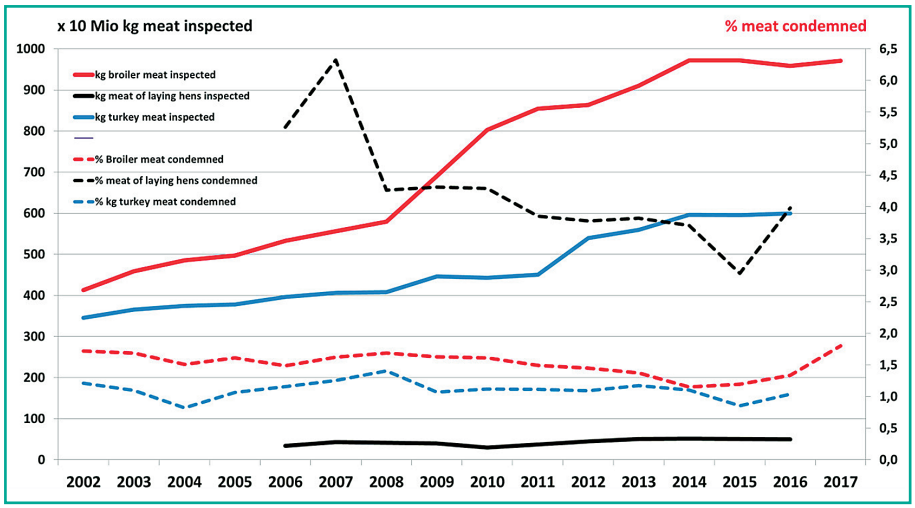

FIGURE 1: *Inspected meat from broiler, laying hens and turkey and percentage of meat from broiler, laying hens and turkey condemned during 2002–2017 (for broiler and turkey) and during 2006–2016 (for laying hens).*

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Looking at the subcategories as reason for complaints for broiler meat, the most often GDACs seen at post mortem inspection were deep dermatitis, ascites and affections at the joints. Other GDACs were less frequent diagnosed (Figure 2). For laying hens the relevant frequent subcategories were ascites, tumors and abscesses, salpingitis and deep dermatitis (Figure 3). According to the GDACs captured, a relevant number of turkeys were affected by deep dermatitis, problems at the joints, hematoma and bruises and unspecific categorized defects under the term general illness (Figure 4).

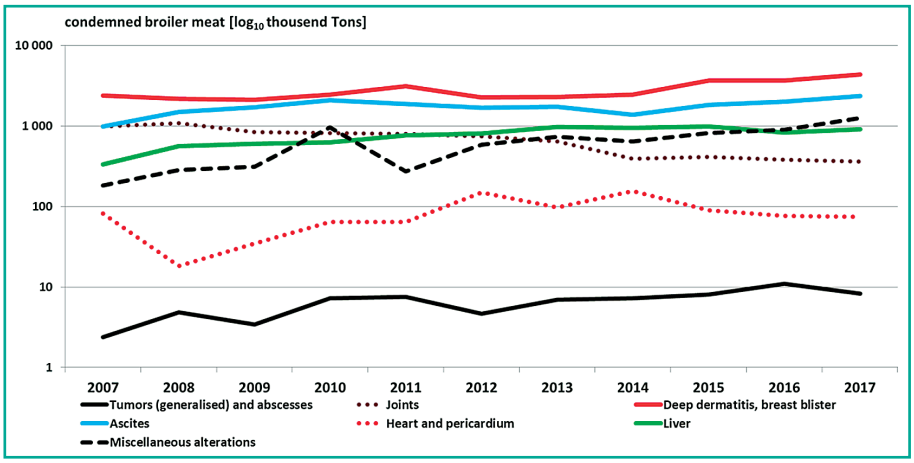

FIGURE 2: *Condemned broiler meat classified by categories of tumors (generalized) and abscesses, deep dermatitis and breast blisters, ascites, findings at joints, liver, heart and pericardium and miscellaneous alterations 2002–2017.*

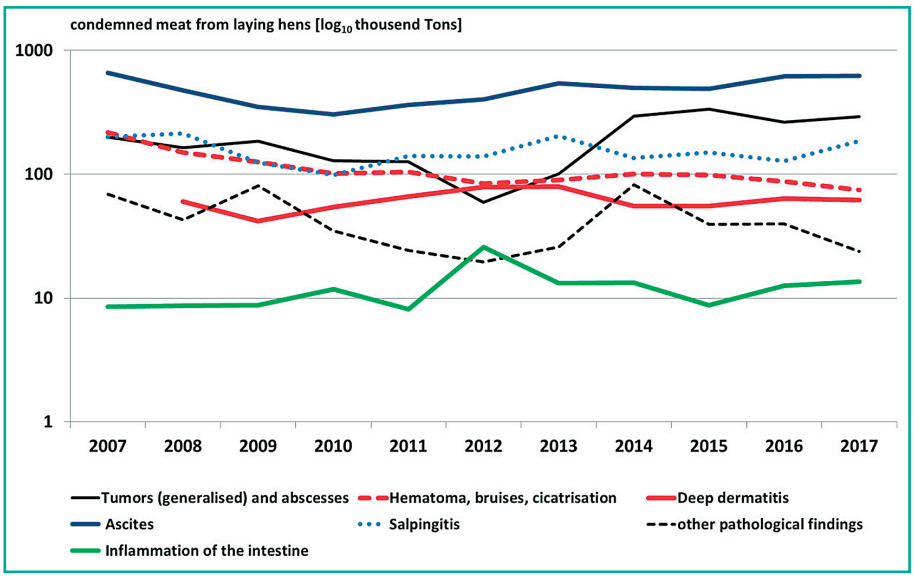

FIGURE 3: *Condemned meat from laying hens classified by categories of tumors (generalized) and abscesses, hematoma, bruises and breast blisters, deep dermatitis, ascites, salpingitis, inflammation of the intestine, and other pathological findings 2002–2017.*

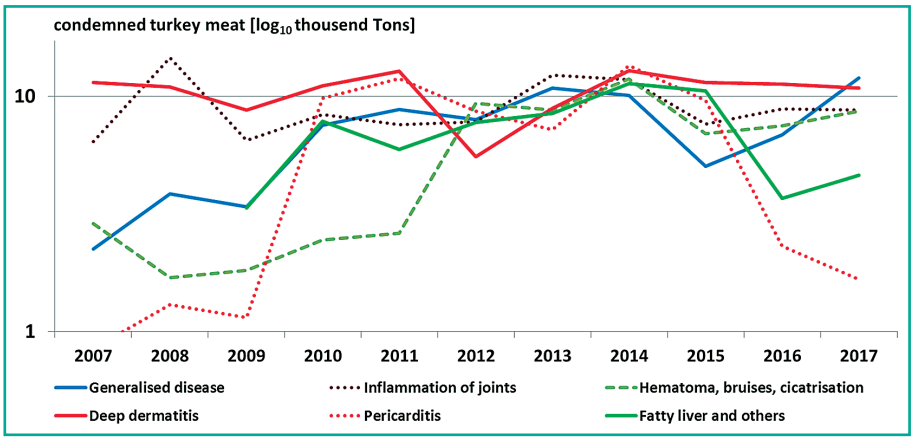

FIGURE 4: *Condemned turkey meat classified by categories of tumors (generalized) and abscesses, deep dermatitis and breast blisters, ascites, findings at joints, liver, heart and pericardium and miscellaneous alterations 2002–2017.*

Discussion

GDACs during meat inspection are primarily defined in relation to food hygiene. But also transparency in food production became more relevant in the farm to fork and in the one health concept. Therefore a synopsis of GDACs with information about animal health and animal welfare is suitable to indicate general health conditions during the earlier fattening or laying period of chicken. GDACs could therefore be a source for feedback from meat inspection to the farm of origin.

To connect specific findings at slaughter with those given in the presetting list of possible options by the Federal Statistical Office to an etiological reason is difficult, because a GDAC does not always have a single cause. Multiple reasons may contribute to a single GDAC. Also a possible inter-correlation between GDACs has to be taken into account if a certain etiology is seen responsible for a GDAC. Due to these obstacles, the interpretation of GDACs at meat inspection and their correlation to ante mortem conditions remains difficult (Ellerbroek, 1997; Salines et al., 2017).

As poultry meat is produced and shipped all over Europe, it could be helpful to compare trends and figures with data from other European countries. Although the breeds used and slaughter facilities are almost uniform, different inspection regimes and regulatory guidelines made a comparison questionable. According to the EU legislation a common list of findings as a basis for decision of the competent authority and a uniform benchmark scheme is missing. However the inspection results in the USA and Canada seemed to be comparable to the German figures (Fries, 2001).

Overall condemnation rate of meat

The figures for the overall condemnation rate for broiler decreased

from 2002 onwards. But since 2014 an increase is obvious from 1.2% to 1.8% in 2017. On the basis of regional data, Alvarez (1981) calculated a condemnation rate for broiler in the same range amounting to 0.83% for 1981 in Western Germany. A lower rate of 0.63% from 1985-1995 is reported by Fries (1993). No historic data are found for laying hens and for turkey to compare these with recent data.

Specific findings as grossly detectable abnormalities and conditions (GDACs)

The interpretation of official listed condemnation categories and their use for feedback to the farm of origin is a controversial issue between food hygienists and clinicians. Several items in the official list of findings do not always relate directly to human health aspects but more to quality and animal welfare criteria. Other important aspects (prevalence of Campylobacter spp., Staphylococcus spp., Toxoplasmosis, Hepatitis etc.) are not adequately addressed in the inspection procedure (Bisaillon et al., 2001). Löhren (2012) argued that the given findings in the Regulation (EC) No. 854/2004 are not sufficient and inappropriate to assess the health status of poultry. As a consequence, findings are assessed unequal in member states of the EU although the legal basis by the European regulation (EC) No 854/2004 is the same. As an example, local and circumscribed inflammation of the skin which are associated with the E.coli-complex (deep dermatitis, avian cellulitis) are judged differently in member states of the EU (Löhren, 1997). A further indication for inconsistence of data is reported by Alvarez (1981) and Fries (1993). Both authors collected information in their field studies about the prevalence of findings and calculated a different ranking of most frequent findings compared to the data from the Federal Office for Statistics. However, despite these deficiencies Stärk and coworkers (2014) stated that trends of findings identified in meat inspection could contribute a substantial input to the control of animal health and to animal welfare if further information from the rearing / fattening or laying period is included. A feedback of relevant findings should be supported by a co-operation between slaughterhouse and farm of origin (Ellerbroek, 1997). Due to these deficiencies not all categories for findings listed by the Federal Office for Statistics seemed to be suitable for the evaluation of the flock health status during the period from 2002–2017 and figures 2 to 4 display only selected condemnation rates.

If selected findings are recorded not only as a reason for condemnation but also in correlation to the etiology / causative agent at the farm of origin the description of findings like deep dermatitis should be upgraded by the localization (peri cloacal, ventro lateral, latero dorsal) to allow a clue about the causative agent or source of damage. Besides specific findings already mentioned the overarching terms like “other pathological changes” or “general illness” should be subject to a close and constant monitoring. A frequent use of this category can be a signal for a new or still undefined disease condition relevant to human and animal health which is recorded under this mask.

Conflict of interest

The author of the above manuscript declares no conflict of interest in relation to this manuscript.

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