Lohmann Information

Cuxhaven, Oktober 2006

Editorial

Ladies and Gentlemen,

thank you for expressing interest to receive the publication Lohmann Information in its new format – online and in English. As you know, it was decided last year to terminate the printed version, which appeared since 1956 with up to 4 issues per year in German and a total of 28 International editions between 1980 and 2003.

Only older readers will remember under which conditions the first issues of Lohmann Information were published: animal and poultry production in Europe was beginning to catch up with more efficient methods developed in America, the gap between theory and application created the demand for publications related to modern animal nutrition and food production in the broad sense.

In our time more and more people expect to find enough information on the internet, and if you know how to ask the right questions, you may be able to satisfy your needs without going to a library or subscribing to all journals of potential interest. To participate in this modern network of information, authors prefer to publish in English and in journals which are also available online. We are following this trend and look forward to your response.

1. This issue starts with **"Heinz Lohmann – a Company Profile"** by **Harm Specht**, who recently retired as board member of the PHW Group and sketched the history of the group of companies in Cuxhaven which emerged from early initiatives of the founder Heinz Lohmann and continue today as members of the PHW and EW Groups, respectively.
2. No poultry disease in history has caught as much public attention as bird flu, and there is continued demand for factual information. **M. Voss**, head of the LTZ Veterinary Laboratory, presents the essentials under the title **"A Manual for the Control of Highly Pathogenic Avian Influenza (HPAI)"**. The important message is: the risks of H5N1 infections have to be minimized by rigorous application of current knowledge until new vaccines become available.
3. The improvement of egg shell quality has been on the agenda for primary breeders of laying hens for decades, and the choice of the measurement techniques determines the rate of progress. The article by **Wiebke Icken, M. Schmutz** and **R. Preisinger** (LTZ) **"Dynamic stiffness measurements with the crack detector"** describes a new method to improve egg shell strength and compares estimates of genetic parameters from a recent generation with previous publications.
4. If you search the internet for information on poultry genetics and welfare, you may find many references to undesirable consequences of increased juvenile growth rate in meat-type poultry, but only limited information on how primary poultry breeders are overcoming negative correlations. For those who are not members of the WPSA, we have reprinted an article by **D.K. Flock, K.F. Laughlin** and **J. Bentley** in World's Poultry Science Journal 61: 227-237 (2005) **"Minimizing losses in poultry breeding and production: how breeding companies contribute to poultry welfare"**. Along the same line, J. McAdam presented new data in his plenary lecture at the European Poultry Conference in Verona, demonstrating that genetic progress continues in desirable directions, despite negative correlations.

With this first online issue of Lohmann Information we like to invite you to send your comments to the editor. Suggestions for topics to be covered in following issues are also welcome.

With kind regards,

Prof. Dr. Dietmar Flock

LOHMANN ANIMAL HEALTH

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LOHMANN TIERZUCHT

Heinz Lohmann - Portrait of a Company

Harm Specht, Cuxhaven

Heinz Lohmann was born on 22 July 1901 as son of a cereals merchant. After completing his highschool education in humanities in Hanover and a commercial apprenticeship, he made contacts in the country trading business and the emerging compound feed sector through his father's company. In the 1930s he went to the USA to gain experience of working abroad.

At the age of 30, Heinz Lohmann founded a fish meal factory in Cuxhaven, working in close cooperation with 20-odd medium-sized companies from the fish processing sector. From modest beginnings, this first factory developed throughout the pre-war years and later became a major player in the industry. Commercial activities were put on hold during the Second World War and processing only resumed in 1947.

Once the restrictions imposed on the German fishing fleet were lifted, and when in the early 1950s the small deep-sea fishing industry began to use part of its fleet for seasonal industrial fishing, the Lohmann fish meal processing plant was able to expand accordingly. At times, over 500 tonnes of raw fish were converted to fish meal in a day. When the characteristic odour of fish meal processing was noticed by visitors of Cuxhaven, Heinz Lohmann liked to answer with the Latin proverb "pecunia non olet" (money doesn't smell)!

Even back in the 1960s it was already apparent that future supplies of fish and fish offal would be limited. While consolidating the Cuxhaven operations, Lohmann merged the fish meal processing plant with a second company based in Cuxhaven. In 1982 a major fire destroyed the facilities in Neufelder Straße, but production was continued using another plant in the same part of town (owned by Unilever at the time).

The rising demand for processed agricultural products – particularly milk, meat and eggs – and the growing numbers of agricultural livestock required fish meal to provide protein as part of an effective diet. The shortages of fish meal led to technical solutions to provide alternative sources of protein.

Amino acids were widely used to replace the natural raw materials. Once again, the Lohmann Group was a key player through its subsidiary "Lohmann Tierernährung" (today Lohmann Animal Health).

Lohmann Tierernährung (LTE), Neufelder Straße, Cuxhaven

In the 1950s and 1960s, scientific and practical research into agricultural production methods was nowhere near as advanced as in the US because of the impact of the Second World War. In the US, uninterrupted research had been incredibly successful. For example, scientists had discovered that a fermentation cake containing antibiotics was very beneficial for livestock health and growth. In addition to producing and marketing fish meal, Heinz Lohmann decided to apply for a licence from an American pharmaceutical company to produce vitamin B12 and substrates containing antibiotics using fermentation processes.

The first licensing agreement concluded with the American company Lederle (17 June 1952) allowed the company's patented techniques to be used in Germany. In just 90 days, a large fermentation plant was built in Neufelder Straße in Cuxhaven and soon after Lomacin (Aureomycin) was released for sale. Producing the feed supplement in aseptic conditions was a major challenge for the factory and the staff. By applying expert scientific advice regarding the ingredients for mixed feed and providing a free-of-charge analysis service, Lohmann soon succeeded in generating a great deal of interest within the German mixed feed industry.

This marked the beginning of a new era for agriculture: in addition to the domestic production of agricultural raw materials (e.g. cereals) and traditional fish meal as a source of protein, feed additives were now available which significantly improved animal productivity.

New legislation in the mid-1970s considerably restricted the use of these additives within the EU, but LTE had a well-established sales network and was able to refocus its manufacturing and product range. The successor to LTE, known today as Lohmann Animal Health GmbH und Co. KG, Cuxhaven, Abschnede (LAH), produces and markets all major feed additives (vitamins, technical amino acids, biologics) and poultry vaccines around the world. The company currently has around 300 employees. The large R&D team provides a constant supply of new and innovative products.

Lohmann Tierzucht (LTZ)

Through his contacts in the USA, Heinz Lohmann learned that, in addition to beef, consumer demand for broilers was on the rise. He arranged study trips for his experts to research genetics and production processes in the USA. He saw huge potential for development in Germany. But the first test flocks of “Masthähnchen” – males of traditional egg-type and dual purpose breeds - were hatched, reared and killed in facilities in Oxstedt near Cuxhaven - were anything but successful, and the press people invited to taste the grillers unimpressed.

Heinz Lohmann was not to give up soon and demanded from his staff to explain what was wrong with production in Germany. Hygiene and disease prophylaxis, nutrition, management and the breeds used were variables to work on. The analysis led to the decision to import a “package” of suitable genetic material and know-how from the USA. In 1957, Lohmann concluded a licensing agreement with the American company Nichols, at that time a leading broiler breeder in the USA. Nichols supplied pure-line day-old chicks and sent experts to Germany to set up a modern broiler operation, from breeding to processing.

In 1964, Lohmann acquired the purelines from Nichols to become an independent broiler breeder and to expand international sales. With the acquisition of Indian River in 1978, it was hoped to gain a significant share of the US broiler market, but eventually broiler breeding was divested. Today, Lohmann Indian River broilers are sold by Aviagen.

In 1958, a further licensing agreement was concluded with Heisdorf & Nelson Farms (H&N) for laying hens, a major player in the market for hybrid layers. Art Heisdorf had been a pioneer in introducing “reciprocal recurrent selection” as a new method of cross-breeding in poultry. The commercial layers from this modern breeding system soon became popular in Germany and other countries as “HNL Nick Chick”. Lohmann gradually adapted the genetic material to meet European needs and eventually acquired the pure-lines from H&N.

In 1987, Lohmann was able to buy the company H&N and transferred the H&N breeding program to Cuxhaven in 1997. LTZ and H&N presently have a combined world market share for egg-type chickens between 25 and 30%. Breeding farms in the Cuxhaven area with up-to-date facilities are supplemented with grand parent and test farms on several continents to ensure continued genetic progress and supply to world-wide customers even during times of global disease risks.

As early as 1957-58, Lohmann set up a veterinary laboratory for routine examinations to maximize bio-security for the valuable breeding flocks. Protective vaccination soon was introduced, with vaccines developed from local field isolates. The successor company, LAH, now produces a full range of poultry vaccines using specific-pathogen-free (SPF) eggs in two new plants in Cuxhaven, Abschnede. Valo SPF eggs are needed to cultivate the vaccines: the eggs are free from pathogens and the associated antibodies and are marketed all around the world as SPF eggs for research and vaccine production. Increasing demand has led to the facilities being expanded several times.

Poultry Processing Plant Contifrost, Cuxhaven-Altenwalde

Starting in the mid-1950s, broiler growing was established as a business activity of farmers in the Elbe-Weser region. The first operation was based in a farm in Oxstedt, near Cuxhaven, and soon the demand exceeded the production potential. In order to meet the growing demand, an old warehouse in Neufelder Straße was converted to a semi-automated slaughter-house. This plant was soon working at full capacity too. The second facility was set up in Präsident-Herwig-Straße with state-of-the-art technology and was able to process 40,000 chickens a day. By the time when a new large-scale plant was built in Cuxhaven-Altenwalde, in 1971, nearly all processing operations were automated. Lohmann's "Goldhähnchen" (golden chickens) – later rebranded WIESENHOF – were sold throughout Germany. Today, WIESENHOF is known across Europe as brand name for quality poultry products.

TAD Pharma

From animal health to drugs for human use: The work in the veterinary laboratory and expertise of the scientists who worked there soon led to the development of a comprehensive range of pharmaceuticals and biologics for poultry. SPF eggs were available for producing in-house vaccines, and in 1968 the TAD Pharma company was founded, which now employs nearly 280 staff. The TAD veterinary department was transferred to LAH in 1996. TAD Pharma now focuses solely on manufacturing and marketing drugs for human use. The company operates state-of-the-art processing plants in Cuxhaven, Abschnede and has grown impressively since it was first created. More than 100 pharmaceutical consultants advise the medical doctors. The company's branded products are well established. A leader among the well-known products is "Harntee 400", a tea to control bladder dysfunction.

Human Nutrition: from Pomps to Nutrilo

The interest of Lohmann in human nutrition may be traced back to the 1940s when the local pharmacist Pomp suggested that Heinz Lohmann should buy and expand a small baby food factory. Pomp provided the recipes and later gave his name to the "Pomps Kindergries" baby food brand. In 1947 the company employed just 4 staff, 3 freelance salesmen and a few trainees. Demand mushroomed and the products captured a significant market share. The company repeatedly expanded to keep up with rising demand and by 1965 sold 1.3 m packets per month, employing 32 people. In 1968, Pomps was sold to the Maizena Group. In 1984, human nutrition interests were reactivated by founding Nutrilo GmbH, Heinz-Lohmann-Straße. Nutrilo focuses on the development and production of vitamin blends for the health food and beverage industry. A significant share of the turnover is allocated to effervescent tablets. Currently Nutrilo employs 60 people.

The entrepreneur Heinz Lohmann

Heinz Lohmann was one of the great pioneers in the European agricultural food industry. As a businessman based in Cuxhaven, he combined a driving force and the will to succeed in a business that was just in its infancy. He soon developed long-term plans for his businesses. He was able to motivate, encourage and challenge his workers and counterparts. Perhaps, occasionally he asked for too much. His standards and methods were unconventional. He was very professional, loved innovation, was willing to take risks and was incredibly dedicated. When he experienced setbacks, his luck always turned and he was able to restructure to stabilise the Group again.

Heinz Lohmann recognized the superior techniques used in the USA before others, and got access to the advanced technology through licensing agreements, which did not require much capital. In the face of considerable opposition from traditional institutions and politicians, he introduced groundbreaking technologies and ensured that the new, better processes were supported by scientific expertise. He also took steps to ensure that developments continued to the present day – a good example of "sustainability".

In 1987, the brothers Wesjohann based in Rechterfeld/Visbek purchased the Lohmann companies in Cuxhaven. Since then, the divisions based in Cuxhaven have expanded considerably with substantial investment to increase the group's long-term productivity. At present, around 700 people are employed in the Cuxhaven area in companies of the former Lohmann Group, now owned by the PHW (Paul-Heinz Wesjohann) or EW (Erich Wesjohann) Group.

In recognition of the contributions made by the pioneer Heinz Lohmann, the current share-holders have created a non-profit foundation named after him. The Heinz-Lohmann-Stiftung GmbH initiates and supports research into food and nutrition of the future. The foundation has already established a reputation through its international conferences. The 6th conference of the Heinz Lohmann Foundation, held May 9th 2006 in Cologne, Germany, was again very well received.

Zusammenfassung

Ausgehend von der Gründung einer Fischmehlfabrik im Jahre 1932 haben sich im Raum Cuxhaven namhafte Firmen entwickelt, die auf Inititiativen von Heinz Lohmann zurückzuführen sind und heute zur PHW- bzw. EW-Gruppe gehören: Lohmann Animal Health (LAH), spezialisiert auf Tierernährung und Tiergesundheit; TAD und NUTRILO, spezialisiert auf Humangesundheit bzw. Humanernährung; sowie Lohmann Tierzucht (LTZ) und H&N, spezialisiert auf Legehennenzüchtung und Produktion von SPF-Eiern für Forschung und Impfstoffherstellung. Die Heinz Lohmann Stiftung beschäftigt sich vorrangig mit Zukunftsfragen der menschlichen Ernährung unter dem Gesichtspunkt intelligenten Ressourceneinsatzes.

A Manual for the Control of Highly Pathogenic Avian Influenza (HPAI)

M. Voss, Lohmann Tierzucht GmbH, Cuxhaven

Introduction

In response to the outbreaks of Highly Pathogenic Avian Influenza (HPAI) in Italy in 2000 and in the Netherlands in 2003 the Central Association of the German Poultry Industry (ZDG) formed a Poultry Disease Working Group in order to discuss and establish necessary measures for the control of Avian Influenza infections in poultry.

Members of the Poultry Disease Working Group of the ZDG were: W. Hoffrogge and K.P. Linn (ZDG) and seven poultry veterinary specialists representing poultry breeding, broiler, duck, laying hen and turkey production (J.J. Arnold, J. Bachmeier, K.-P. Behr, U. Löhren, M. Pöppel, G. Reetz and M. Voss).

The working group published a ***Manual for Avian Influenza (HPAI)***, covering the fields of epidemiology, diagnosis, personnel and transport vehicle hygiene, killing of poultry in the event of a disease outbreak, vaccination, measures for the protection of employees as well as the relevant German legislation in animal disease control. Although this manual has been basically a response to the 2003 outbreaks of HPAI H7N7 in Europe most of the chapters are still valid also for the current situation with HPAI H5N1 in Asia, threatening the world's poultry population.

This article represents a summary of the Manual for Avian Influenza. The full text has been put on the WPSA website, where it is available under
http://www.wpsa.com/downloads/ZDG%20Handbuch%20Gefl%FCgelpest%20E.pdf

1. Epidemiology

Ongoing epidemiological studies (avian influenza monitoring) in non-outbreak times, i.e. irrespective of a current HPAI outbreak, have been established in Germany as the LPAI Monitoring Program for slaughter turkeys, which was introduced and sponsored by the Association of German Turkey Producers in 2000 following the avian influenza epidemic in Italy. Such monitoring programs should be implemented as a self-monitoring system by the whole poultry industry in the form of spot checks in conventional holdings and on a flock basis in free-range holdings.

A continuous cultural avian influenza monitoring scheme should be introduced for wild fowl. This should be carried out in collaboration with bird protection/bird spotting stations and ringing centers and also involve the hunting community where appropriate (diagnostic shooting). In each federal state a representative number of wild fowl (wild waterfowl, coastal fowl and other wild fowl) should be sampled (faecal samples or cloacal swabs).

According to the Federal Catalogue of Contingency Measures for Avian Influenza, in an outbreak situation all animals, people and equipment potentially exposed to the virus on the affected holding for up to 21 days preceding the appearance of clinical symptoms shall be identified, recorded and monitored. This is done by the competent veterinary authorities in collaboration with representatives of the federal state concerned.

Depending on the risk of transmission of avian influenza by animals, people, equipment, vehicles, etc., such investigations and surveys shall distinguish between three types of contact holding:
K1 holdings are poultry farms/holdings which had exchanged live animals (including non-poultry species such as pigs) with the infected holding during the preceding 21 days. Once the suspicion of avian influenza has been confirmed on the original holding by molecular biological tests the infected flocks shall be immediately killed and safely disposed of.
K2 holdings are poultry farms/holdings where person-to-person contacts with the infected holding have taken place during the preceding 21 days. All persons who entered the poultry building/buildings, e.g. veterinarians, attendants/consultants, workmen, depopulation teams, should be identified. It should also be ascertained on which poultry holdings these persons worked subsequently.

The definition of a K2 holding also extends to farms with contact through vehicles, equipment and items that were used on the infected holding and might subsequently have been used on other poultry farms.
Once the suspected outbreak on the original holding has been confirmed by molecular biological tests, all flocks on K2 holdings with contact to the infected holding within a period of 5 days prior to the emergence of clinical symptoms must immediately be culled and safely disposed of. Flocks on K2 holdings with contact to the infected holding within a period of 6 to 10 days prior to the emergence of clinical symptoms and with inadequate hygiene and precautionary measures should also be culled and safely disposed of. Flocks on K2 holdings with contact to the infected holding which do not need to be emergency culled should be placed under official supervision for 21 days.

The definition of a K3 holding does not yet exist in animal disease control terminology. The term is suggested for the following types of contact:
K3 holdings are poultry farms/holdings which have had contact with the infected holding via people (not entering poultry buildings), vehicles, equipment etc. (e.g. feed vehicles, carcass disposal vehicles and their drivers, other social contacts by the poultry keeper) within a period of 48 hours prior to the emergence of clinical symptoms, in whose immediate vicinity (within about 500 m of the poultry building) manure from the infected holding was spread within 14 days prior to the emergence of clinical symptoms. K3 holdings should be closed by the veterinary authorities for a period of 21 days.

In case an outbreak of highly pathogenic avian influenza has been confirmed, the monitoring activities during non-outbreak times should be extended by epidemiological surveys of the wild fowl population, in particular the less susceptible pigeon and water fowl population in the protection and surveillance zone. In emergency situations shooting of huntable wild fowl species that are susceptible to avian influenza such as crows and wild pigeons should be stepped up.

2. Diagnosis

Directive 92/40/EEC, based on the existing definition of avian influenza, also lays down the diagnostic procedures to be applied for confirmation of the presence of avian influenza (HPAI – Highly Pathogenic Avian Influenza).

Previous outbreaks of avian influenza in the Netherlands, Belgium and Germany have shown that the disease does not present itself with a uniform clinical and gross pathological picture. While symptoms such as reduced water and feed intake, a drop in egg production in conjunction with swellings and blue discolorations on the head and legs and respiratory symptoms, followed by increased mortality rates with inflammations of the serous membranes and petechial haemorrhages of the internal organs provide initial indications of the presence of avian influenza, these symptoms can also be caused by other infections.

Before making a presumptive clinical diagnosis of avian influenza it is therefore necessary that, in addition to the attending veterinarian and the veterinary official, an independent veterinary poultry specialist with expertise in the particular species should be consulted in order to rule out other potential causes. It is advisable that once a certain mortality threshold without apparent explanation (in the Netherlands this was set at 2 % over 24 hours) has been exceeded, exploratory tests should be carried out (M-PCR or virus culture) before suggesting the presence of avian influenza.

Diagnostic procedures differ between those for the detection of antibodies and antigen assays.

When performing **antibody assays** a distinction has to be made between test systems which detect antibodies to all avian influenza viruses (group-specific antibodies) and those capable of differentiating between antibodies to specific haemagglutinin (HA) subtypes (subtype-specific antibodies). Detection of group-specific antibodies is done by the agar gel precipitation test (AGPT) or the ELISA assay. HA subtype-specific antibodies are detected by the haemagglutination inhibition (HI) test.

Antibody assays are capable of detecting, via a monitoring program, infections with low pathogenic avian influenza virus (LPAI). If an outbreak of highly pathogenic avian influenza (HPAI) is suspected, antibody assays are of little diagnostic value because there is insufficient time for birds to develop antibodies due to the peracute course of the infection.

Antigen assays for the detection of Influenza antigen are performed by classic virus cultivation in SPF embryo culture and by molecular biological procedures (PCR, sequencing). Virus cultivation in SPF embryos and the performance of PCR assays for detection of avian influenza genome in general (M-PCR to detect the group-specific matrix protein) are done in regional and private laboratories according to the method specified by the national reference centre. Nationwide facilities for this purpose must be created.

At least for the confirmation of an initial outbreak the subtype-specific PCR for viruses of subtypes H5 and H7 (H5/H7-HA-PCR) should only be conducted by the National Reference Laboratories for Avian Influenza because of potentially required confirmatory tests. In the event of an initial outbreak the national reference laboratory shall also determine the intravenous pathogenicity index (IVPI) in SPF birds.

Characteristic features unique to particular poultry species may require that only specific diagnostic procedures can be used. There is some doubt for example whether avian influenza virus is sufficiently invasive to induce antibodies in water fowl. In this instance direct virus isolation (virus culture, PCR) is probably the preferred method.

3. Personnel and transport vehicle hygiene

The avian influenza epidemics confirmed again that person-to-person contact and vehicle traffic are primarily responsible for transmission of the virus. The network of business relationships between poultry operations beyond state and administrative borders require correspondingly complex precautions against avian influenza. Animal disease contingency plans for a poultry holding or integration should be divided into two alert levels. The measures for level II are in addition to those of level I.

Alert level I should be in place when an outbreak of avian influenza occurred in a region without economic links (transport of feed, hatching eggs, live poultry, manure) to the holding/integration. An outbreak of avian influenza in a region with economic links (transport of feed, hatching eggs, live poultry, manure) to the holding/integration should result in **Alert level II**.

Personnel hygiene for alert levels I and II must include isolation of the farm and poultry buildings. Movement of people must be controlled and restricted to the minimum necessary (visitors' book). Only persons wearing the protective/disposable clothing are allowed into poultry buildings, disinfectant mats and foot dips at entrances to poultry buildings have to be used. Catching or loading teams must follow a strictly coordinated hygiene program (protective clothing, work only within regional borders). Access must be prohibited for individuals who have visited infected areas or had contact with infected holdings. Veterinary flock inspections should be reduced to a minimum. Medicine regulations, animal vaccine order and meat hygiene legislation should be amended to cover the specific outbreak situation in order to avoid unnecessary contact through movements of people and vehicles.

General rules for **transport vehicles**, like log books with proof of disinfection, use of compulsory routes, central washing and disinfection stations, installation of commercial facilities for cleaning and disinfecting vehicles in the vicinity of the farm and written training manuals for own drivers should be implemented.

General rules for cleaning and disinfection during **transport of live poultry** should be applied during alert level I. In addition, during alert level II disposable clothing and overshoes should remain on the premises and one-way packaging material should be used. Corridors between broiler farms and abattoirs should be created by the veterinary authorities and the poultry industry for the transport of slaughter poultry.

Similar requirements apply for the **transport of hatching eggs**, including compulsory disposable packaging at all alert levels, and the **transport of table eggs**.

Because of the high potential for disease spread transport of feed must include single delivery runs, use of disposable dust bags for capturing feed dust at the silo and daily cleaning and disinfection of feed vehicles. Compulsory routes should be established during alert level II.

Transport of litter material of any kind must be prohibited from protection and surveillance zones into uninfected areas. The removal of poultry manure always poses a considerable disease risk, especially if the manure is spread in close vicinity of other poultry holdings. All poultry manure transports, both local and remote, must be recorded in order to monitor the whereabouts of the material.

Transports of carcasses, hatchery residues and slaughter by-products to carcass disposal plants must include cleaning and disinfection of vehicles before each transport. Carcass disposal must be carried out in strict compliance with the system of clean/dirty separation. No carcass disposal vehicles are allowed into poultry facilities. Vehicles must drive straight to specific holdings, a compulsory route should be established and vehicles must have no contact with infected regions.

4. Killing of poultry in the event of an outbreak

The immediate slaughter of the flock suspected of being infected has top priority in disease control. As the infection is not necessarily associated with very high mortality it has to be accepted that this action is necessary to contain virus shedding. The personnel and equipment used in the culling, however, pose a major risk of disease spread. Once a buffer zone has been established around the infected holding, culling should start there from the outside in to prevent the virus from being carried outside the zone during the culling action. The granting of exemptions from a culling order, for instance in the case of vaccinated zoo birds or vaccinated individuals of rare poultry breeds, poses the risk of retaining virus shedders. If necessary, special rules may have to be introduced for handling these poultry categories.

Killing poultry outside closed housing systems in containers or mobile electrocution facilities poses the danger of windborne disease spread through feathers, faecal particles or dust. Moreover, not all poultry sites have outside yards that are sufficiently solid for adequate cleaning and disinfection. A closed-house culling operation is therefore preferable in order to contain the spread of the disease.

For any killing method animal welfare aspects have to be considered. Successful disease control is applied animal welfare. In addition, emergency culling for animal welfare reasons may become necessary if poultry cannot be transported because of official movement restrictions. To prevent broilers from growing beyond marketable body weight, it may be in the interest of bird welfare to kill flocks in affected areas.

Epidemiologists agree that culling actions within a restriction zone must be completed with 48 hours of taking the decision. The time factor in the implementation of stamping out is currently not covered by the German Poultry Disease Order. An amendment should therefore be considered.

Killing procedures

German legislation provides expressly that in the event of a contagious animal disease outbreak the competent authority is empowered to take discretionary decisions concerning slaughter procedures. The following procedures are suitable for killing poultry in the event of an avian influenza outbreak: Poultry house gassing with CO_2, container gassing with CO_2, poultry house gassing with CO, electrocution, poultry house gassing with HCN, killing by lethal injection (for example T 61) and neck dislocation.

Chemical procedures for killing poultry via the feed or drinking water have been tested and are currently considered unsuitable.

Poultry house gassing with CO_2 is the method of choice wherever possible but requires special equipment and the supply of sufficient CO_2. CO_2 may be pumped at high pressure (20 bar) into the poultry house and sprayed through numerous ultrafine nozzles spaced at about 20 m intervals. In layer hen cage systems the spray nozzles are positioned on top of the batteries so that CO_2 permeates the cages from top to bottom.

Container gassing with CO_2 requires special gas-tight containers with lids. The lids have openings for entering the chickens, which are then exposed to a CO_2 concentration of above 60 % within the container. The culling capacity per container lid is about 2,000 chickens/h, bringing the total number culled in two shifts to about 32,000 chickens per day.

To avoid the risk of explosions, **poultry house gassing with CO** may only be used by companies with specialized expertise and under the supervision of the local fire brigade. For the same reason the procedure has been ruled out for container gassing. The current version of the German Federal Catalogue of Contingency Measures expressly prohibits the use of this procedure. The Working Group suggested that this procedure should be added to the authorized list in the event of an avian influenza outbreak.

The first poultry **electrocution** facility of the Animal Diseases Insurance Fund of Lower Saxony has a capacity of 4,000 chickens or 1,000 turkeys per hour. The labor requirement is about 10 workers. Mobile electrocution units are usually so large that the culling operation takes place outdoors. Electrocution is the preferred method for killing water fowl because their biology is such that they can hold their breath for a very long time in gas stunning procedures. There are concerns whether the unit can be completely disinfected und hence worries that such devices might spread disease.

Because of the extreme toxicity of hydrogen cyanide poultry house gassing with HCN, too, should only be carried out by qualified personnel. Carcass disposal plants have expressed concern that they might not be able to dispose of carcasses killed by this method because of potential residues.

Killing by lethal injection, using injectable drugs such as T 61 or barbiturates is appropriate for killing individual birds, for instance on pedigree or hobby poultry farms.

As pointed out above, the suitability of any culling procedure depends essentially on the type of construction of the building and its location. Poultry farms should therefore be **categorized** and suitable culling procedures stipulated for each type of building; as well as the procedure of choice, fall-back procedures should be suggested in the event of technical, logistical or personnel constraints.

Selection of personnel for culling operations is one of the most critical factors. Since people are the most likely transmitters of the virus between holdings, especially over long distances; it is imperative that personnel carrying out the culling should have no contact with other poultry holdings. This means that catching/loading teams, which used to be the preferred choice for this type of work, are either ruled out or provisions must be made which ensure that some loading firms work exclusively in disease control, on a temporary basis, while others continue to work only outside the infected area in their standard business.

In all countries which have had outbreaks of avian influenza, the disposal of dead or culled poultry has always been done by burial in local landfills, as in Italy in 1999 and in the United States (Virginia) in 2001. This might be done not only because of a capacity shortage in carcass removal plants, but specifically in order to prevent the spread of the virus. For this reason the safe disposal of infected and suspected contaminated flocks by composting on site is also recommended. The temperatures generated during the composting process reliably kill the virus. The final disposal can be done later by incineration or burial. Ideally, composting should be done on the farm premises in order to avoid any risk of virus spread.

5. Audit sheets for large-scale culling of poultry in the event of an outbreak

Knowledge of the type of construction of a poultry house and its location is crucial for the selection of a suitable culling procedure. Poultry housing should therefore be categorized. The categorization should be the result of a visit by expert inspectors. An example is given in the full version of the manual.

6. Vaccination

Although Directive 92/40/EEC theoretically allows vaccination against avian influenza with officially approved vaccines to be carried out along with other control measures in the event of a disease outbreak, vaccination against highly pathogenic avian influenza is currently inadvisable for the reasons given below:

- Vaccinated flocks will continue to shed the virus, which is why vaccinated flocks must be considered potentially infectious. They consequently pose a non-controllable risk of spreading the virus.

- None of the vaccines currently on the market are capable of inducing a sufficient level of immunity in broiler flocks.

Vaccinated flocks must therefore be considered as potentially infectious. Consequently, vaccination of individual flocks against highly pathogenic avian influenza (HPAI) is inadvisable. Blanket vaccination of all poultry flocks, including all small flocks, is unrealistic and non-viable.

In order to protect against avian influenza the vaccine has to contain the same haemagglutinin subtype (H) which would potentially be encountered in the field. The neuraminidase subtype (N) is of lesser importance and can therefore differ from the field virus. This distinction has been exploited in recent years in Italy by applying the so-called “DIVA” principle (Differentiating Infected from Vaccinated Animals). The idea of the DIVA principle is based on the fact that by demonstrating antibodies to the neuraminidase subtype of the field virus, which differs from vaccine virus, it is possible to diagnose an infection in vaccinated flocks. But this requires that a sufficient quantity of **field virus (i.e. in this case highly pathogenic influenza virus!)** multiplies in the flock to trigger an immune response (antibody) in the birds. This may take three to four weeks after infection has occurred, especially if the poultry are protected by existing immunity so that antibody formation is delayed. During this period there is a **danger of undetected spread** of virus. The use of sentinel birds would also delay diagnosis of an infection because vaccinal protection of the vast majority of the poultry population reduces virus shedding and hence infection pressure on the sentinel birds. These would fall ill far later than if infection and virus replication could sweep through the flock unchecked. Using sentinels therefore poses the great danger, at least in vaccinated flocks, that infections are diagnosed too late and that the virus is transmitted to susceptible populations.

For the same reasons the success of ring vaccination is also highly questionable because it takes too long for sufficient vaccinal protection to be built up in susceptible populations and, in broiler flocks, is impossible anyway. Recent experiences from the Netherlands have shown that because of the extremely fast spread of the infection an area of several 100 kilometers around the outbreak would have to be vaccinated in order to hit immune poultry populations as the infection spreads.

8. Specific measures to protect workers from infections with highly pathogenic avian influenza

German rules on worker safety measures reflect current developments in safety technology, health at work, hygiene and occupational science when handling biological agents. One of these rules covers activities in livestock production where biological agents may be involved.

These measures apply to activities during which workers may come into direct contact with the virus of highly pathogenic avian influenza. Direct contact occurs when handling infected birds, during examination, treatment, care and transport of people who are considered to be either suspected or confirmed cases of avian influenza or when performing activities involving contact with bodily fluids or excretions of animals or humans, as defined in 1 and 2 above.

The causal agent of highly pathogenic avian influenza is an influenza A virus of the H5 or H7 subtypes and is categorized in risk group 2 for both humans and animals.

Infected poultry shed the virus in high concentrations with all body excretions (faeces, saliva, tears fluid), faeces in particular being highly infectious.

Transmission to humans can occur by the aerosol and smear infections via mucous membranes. Direct contact with infected poultry, their excretions or contaminated products and materials appears to be necessary for transmission. Indirect transmission by aerosol is also possible if a lot of dust is generated. The risk of human infection is generally considered low and has so far occurred only in the case of viruses of the H7N7 and H5N1 subtypes.

When handling infected (or suspected of infection) poultry and contaminated poultry materials (body parts, body tissues, blood, feathers, poultry excretions including used litter), when slaughtering infected birds and during cleaning and disinfection operations the generation of dust and other aerosols should be minimized. One way of achieving this is to kill the birds by flooding the poultry house with carbon dioxide. The dead flock should be moistened with a fine water mist and the subsequent carcass collection and disposal should be done with as little dust exposure as possible.

Livestock areas containing infected (or suspected of infection) poultry should only be entered by personnel to do the necessary work, and their number should be kept to a minimum. When entering poultry areas special clothing and protective gear should be worn, which must be removed before leaving the area and stored in tightly closed containers for professional cleaning/disinfection or disposal in such a manner that the spread of virus is prevented.

After removing the workwear/protective clothing a whole body shower should be taken and the hands then disinfected. Specific legal requirements relating to animal disease control must be observed.

Health and safety at work rules do not require employers to offer their employees influenza vaccination with the current human influenza virus since this vaccination does not confer protection against infections with the virus of highly pathogenic avian influenza.

However, doing so could prevent double infections with human influenza viruses and avian influenza virus, which would pose the risk of emergence of new human pathogenic virus variants; it might therefore be advisable, in order to protect the population at large, to provide vaccination for employees who might potentially come into direct contact with infected poultry. Employers are required to offer prophylactic antiviral therapy with neuraminidase inhibitors to employees who might potentially come into direct contact with infected poultry. Sick people with flu symptoms should not be allowed to come into direct contact with potentially infected poultry.

9. Legislation related to animal disease control

Legislation related to animal disease control varies between countries. Within the European Community Directive 92/40 EC describes Community measures for the control of avian influenza to be taken in the event of an outbreak of highly pathogenic avian influenza.

This Directive and additional German legislation is available in the full version of the Manual for Avian Influenza.

Zusammenfassung

Ein Handbuch zur Kontrolle hoch pathogener Vogelpest

M. Voss, Cuxhaven

Diese Übersicht gibt in verkürzter Form den Inhalt eines Handbuchs wieder, das der Zentralverband der Deutschen Geflügelwirtschaft (ZDG) in Zusammenarbeit mit namhaften Fachtierärzten für Geflügelkrankheiten herausgegeben hat. Die Grundsätze beruhen auf Erfahrungen in Italien (2000) und den Niederlanden (2003), sie gelten aber ebenso für die gegenwärtig im Mittelpunkt des Interesses stehenden Risiken von H5N1 Infektionen. Das Handbuch ist in deutscher Sprache vom ZDG zu beziehen.

Dynamic stiffness measurements with the “crack detector”: a new method to improve egg shell strength

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Introduction

For the egg industry and consumers, an intact shell is the first and most important egg quality criterion. Unless the egg has an intact shell, it is downgraded and not saleable as quality shell egg. Various sources of variation in shell quality have been reported in the extensive literature, including strain, age of hen, nutrition, health, cage design and other mechanical stress factors from oviposition to the consumer. It is common knowledge that egg shells become more susceptible to breakage as hens get older and the eggs larger, but the percentage of shell defects varies between strains and depends on nutrition and management (SCHOLTYSSEK, 1994).

Primary breeders of egg-type chickens have always included shell strength in their breeding goals and improved shell strength at given age, but the problem remains that the incidence of defective shells increases toward the end of the laying period and is often the main reason for terminating a flock when production is still above 80%. Data to predict egg breakage later in life are usually collected before one year of age, when the main selection on part records is due. At this early age, most eggs have good shells and the accuracy of predicting the rate of breakage depends on the method used to evaluate shell quality.

CARTER (1971) concluded from pilot experiments that most cracks occuring in battery cages at oviposition are produced when the eggs drop on the cage floor. Variables affecting the probability of breakage at this point include intrinsic shell characteristics, but also the mass of the cage floor, egg mass and the drop height, for which the author documented breed differences in another paper (CARTER, 1975).

A multiple regression analysis of strain differences in random sample tests showed that shell colour, shell thickness, egg production and egg weight had significant effects on the incidence of cracks and other defects (CARTER (1975), from which the author concluded that “breeders who wish to exercise indirect selection for low crack incidence should consider selecting for dark shell colour rather than high shell thickness”.

This idea is not helpful for the improvement of shell strength in White Leghorns, but as shown by BONITZ and FLOCK (1992) it is only a question of selection intensity to increase breaking strength in white-egg strains, even above the level of brown-egg strains. The question remains: what are the most useful indirect shell quality criteria for a breeding program to reduce shell breakage under commercial conditions? In this paper, we will review different criteria of shell quality and present new estimates of genetic parameters, with special attention to dynamic stiffness.

Shell quality criteria

Direct selection against defective eggs cannot be very effective, because the incidence of shell defects is too low to exert significant selection pressure at the time of the main selection, when the hens are less than one year of age. A simple way to support adequate shell quality is to include only eggs with apparently normal shells in the egg count, which can change the correlation between egg production and shell strength from slightly negative to zero or even slightly positive (FLOCK, 1990).

Indirect selection for shell strength is being practiced by primary poultry breeders, using a variety of destructive and non-destructive methods. The latter have the advantage that the eggs can still be used after measurement, but in view of the low price per egg and EU food safety regulations, this argument carries less weight than speed and accuracy of measurement, heritability and genetic correlation with shell damage under commercial conditions. The following indirect methods differentiate between eggs with apparently normal shells.

1. Shell percentage: Eggs with intact shells have about 10-11% shell, which can be measured by weighing first the whole egg, then breaking it to remove the contents, weighing the shell and expressing it as percentage of egg weight. Depending on the purpose of measurement, it may be sufficient for routine evaluation to remove residues of egg white with a tissue; for more precise measurements, the shell is dried in an oven before weighing.
2. Shell thickness: This trait is highly correlated with shell percentage and may be measured in different regions. Measurement in the equatorial region is preferred, where thickness is more uniform than in the pole regions. To withstand the stress of handling from point of lay to the consumer, eggs should have a uniform shell of about 0.35-0.40 mm thickness.
3. Specific gravity: Shell percentage and shell thickness can be estimated from the specific gravity of eggs, because the shell has about twice the specific gravity of the egg contents, yolk and albumen. The method is simple and non-destructive, but has the disadvantage that the specific gravity of an egg can decrease considerably during 24 hours, depending on holding temperature. We have found unsatisfactory correlations between specific gravity and the incidence of cracked and otherwise damaged shells (VON HAAREN-KISO et al., 1985) and therefore changed to shell breaking strength as the main selection criterion.
4. Shell breaking strength: To determine their breaking strength, eggs are placed between two plates and subjected to increasing pressure until the shell breaks. The force necessary to break the shell is expressed in Newton. Measurements can be made between the poles or at the equator, simulating different risks of breakage under field conditions. Measurements between the poles, as practiced e.g. in German random sample tests for many years (PREISINGER et al., 1998), have a higher repeatability (SCHOLTYSSEK, 1994). Breaking strength is lower at the small end, but the variation is unaffected by the position during measurement (CORDTS et al., 2001).
5. Structural properties: A classical paper on the structure of egg shells with older literature is the dissertation of SIMONS (1971). Since then, a research group in Glasgow has published extensively on structural properties of the eggshell (BAIN, 2004), confirming that thicker shells are not necessarily stronger. More important is the uniformity of shell formation, which can be analysed by microscopic inspection. For routine genetic analyses, these techniques would be too time-consuming.
6. Dynamic stiffness - K_{dyn}: A promising new method to describe egg shell stability is dynamic stiffness (DUNN et al., 2005a), measured as Kdyn value. The machine is called „Crack Detector“ and uses the same physical principles as large commercial egg graders which sort out eggs with hair cracks and other defects. The dynamic force is a little hammer, which hits the egg to generate shell vibrations. During the measurements the egg is turned around its equatorial axis and hit four times. The frequency of vibrations is recorded by a laterally positioned microphone. The method was first described by COUCKE et al. (1999). DUNN et al. (2005a,b) reported the first heritability estimates and concluded that a large part of the total variance is genetically determined. Moderately high genetic correlations were found between K_{dyn} and shell breaking strength (r_g=0.49), somewhat lower with shell thickness (r_g =0.34).

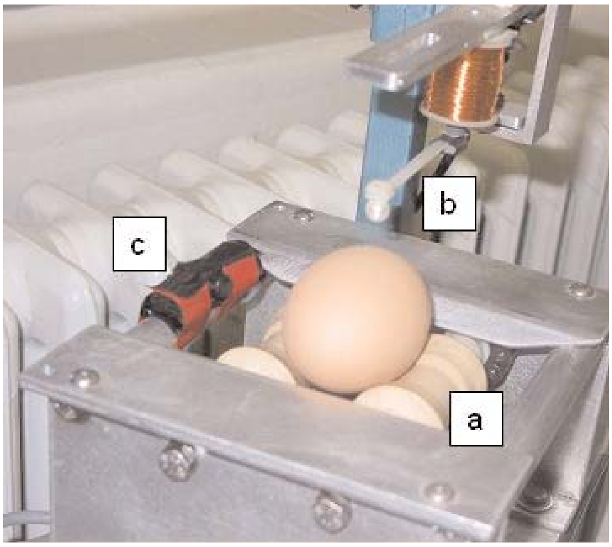
Material and Methods

For the present study we used a total of 2520 eggs from 1000 pedigreed pureline hens from the same commercial Red Island Red line as used in the earlier analyses by DUNN et al., three generations later (data collected in 2005). The hens were daughters of 385 dams and 60 sires, hatched on the same day and kept under the same management conditions from hatch to the time of egg collection. When the hens were 37, 38 and 39 weeks of age, one day’s production was marked with the individual cage number.

Data collection started with a test run over the “crack detector” to eliminate eggs with hair cracks and other defects. In the first week, 6 % of the eggs were sorted out by the machine, but this apparently included some “false positives”. In the second and third week, this percentage was reduced to 4 and 2 %, respectively, by closer inspection of the rejected eggs and repeated measurement before elimination.

The eggs with apparently intact shells were then measured as follows:
(1) length and width to calculate the shape index (100*width/length),
(2) egg mass and frequency of vibrations to calculate dynamic stiffness
$K_{dyn} = 4\pi^2$ * Egg mass [kg] * Resonant frequency [Hz]^2
(3) shell breaking strength (between the poles)
(4) shell weight (after drying) to calculate shell percentage
(5) shell thickness (at the equator).

The “crack detector” used for measurement of the resonance frequency is shown in figure 1.



a: rollers
b: impact hammer
c: microphone

Results and Discussion

Means and standard deviations for 8 traits measured or calculated are shown in table 1 for each of the three samples.

Table 1: Means ($\bar{x}$) and standard deviations (s) of egg quality traits measured

Age of hens	37 weeks n=816		38 weeks n=836		39 weeks n=868	
Trait	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
Egg weight (g)	64.3	4.8	64.8	4.8	65.4	4.8
Shell weight (g)	6.5	0.6	6.7	0.6	6.7	0.5
Shell percentage (%)	10.3	0.9	10.4	0.8	10.3	0.7
Shell thickness (mm)	0.39	0.03	0.40	0.03	0.41	0.03
Breaking strength (N)	56.2	12.2	57.3	12.6	58.2	11.3
Shape Index (100*W/L)	78.4	2.9	77.9	3.0	77.8	2.6
Res. Frequency (Hz)/100	47.89	3.41	48.29	3.34	48.21	3.15
Dyn. stiffness (K_{dyn})/100[1)]	14.75	1.87	15.10	1.78	15.19	1.69

[1)] K_{dyn}=m*RF^2 with m=Egg mass in kg; RF=Resonant frequency;
Note that we did not use the constant $4\pi^2$ here and divided the original figures for RF and K_{dyn} by 100 for more convenient presentation

Estimates of heritabilities and genetic correlations are shown in table 2 for six traits of major interest. These estimates are based on averages of up to three eggs per hen.

Table 2: Estimates of heritabilities (diagonal) and genetic correlations (off-diagonal) among different egg quality traits

	Egg weight	Stiffness K_{dyn}	Breaking strength	Shape Index	Shell thickness	Shell percentage
Egg wt.	**0.54**	-0.14	-0.57	-0.09	+0.10	-0.49
K_{dyn}		**0.40**	+0.57	+0.41	+0.20	+0.39
Break.Str.			**0.10**	+0.42	+0.39	+0.73
Shape				**0.38**	+0.14	+0.09
Thickness.					**0.19**	+0.75
Shell pct.						**0.32**

The heritability estimate for the new trait K_{dyn} ($h^2 = 0.40$) is of similar magnitude as for shape index and higher than for the other shell quality criteria, especially breaking strength. The low heritability of breaking strength compared to estimates reported in the literature is due to the fact that we calculated h^2 on the basis of a single egg, whereas previous estimates are based on the average of several eggs per hen. Breaking strength has a lower repeatability than the other shell quality criteria, i.e. the heritability can be increased significantly by evaluating more eggs for breaking strength.

Intensive selection for shell quality on the basis of breaking strength during many generations may have used up some of the useful variation in this trait, whereas the new trait varies in a dimension of shell quality which has not been selected on so far. The genetic correlation of +0.57 between the K_{dyn} value and breaking strength is significantly below 1.0, indicating that these two traits have a common basis, but measure different aspects of shell strength. Desirable from a breeder's point of view is the lower genetic correlation between K_{dyn} and egg weight, compared to breaking strength.

Index selection for multiple objectives takes the heritabilities and genetic correlations among all traits into account. The combination of optimal egg weight with adequate shell strength is obviously easier to achieve if the correlation is less strongly negative than for breaking strength. Desirable from a breeder's point of view are also the lower genetic correlations of K_{dyn} with shell thickness and shell percentage (0.20 and 0.39), compared to breaking strength (0.39 and 0.73). If shell strength can be further improved without increasing shell percentage, this would also be of special interest for the egg breaking industry, for which shell mass is an undesired by-product.

The results of this study confirm estimates by DUNN et al. (2005a,b) who reported h^2 values for K_{dyn} between 0.33 and 0.53, depending on the statistical model used. The genetic correlations around 0.50 among different measures of shell quality agree well with the publications by BAIN (2004) and DUNN et al. (2005a,b). Contrary to our findings, DUNN et al. (2005) found essentially no correlation between egg weight and shell strength and a slightly negative correlation with egg production. As shown earlier by VON HAAREN-KISO et al. (1985), the negative correlation between shell quality and egg production disappears if only eggs with intact shells are included in the egg count.

To demonstrate the effect of a moderate „selection" on the basis of shell breaking strength vs. dynamic stiffness, we calculated the phenotypic averages per hen (corrected for week of measurement and missing values) and sorted on breaking strength and Kdyn, respectively. In table 3, the upper and lower 25% are shown for the primary selection trait (in fat print) and the correlated response in other traits. The differences are also expressed in phenotypic standard deviations.

Table 3: Characteristics of upper and lower 25% hens phenotypically “selected” on K_{dyn} compared to breaking strength

Phenotypic selection on breaking strength						
			upper 25%		lower 25%	
Trait	Mean	s	Diff.	Diff/s	Diff.	Diff/s
Breaking strength	**57.2**	**10.1**	**+9.80**	**+0.97**	**-12,65**	**-1.25**
K_{dyn}	15.02	1.79	+0.52	+0.29	-0.62	-0.35
Egg weight	64.8	4.8	-0.67	-0.14	+1,86	+0.39
Shape index	78.0	2.8	+0.31	+0.11	-0,42	-0.15
Shell thickness	0.40	0.03	+0.01	+0.33	-0,01	-0.33
Shell percentage	10.2	0.7	+0.36	+0.46	-0,41	-0.52
Phenotypic selection on K_{dyn}						
K_{dyn}	**15.02**	**1.79**	**+2.05**	**+1.15**	**-1.98**	**-1.11**
Breaking strength	57.2	10.1	+3.26	+0.32	-2.59	-0.26
Egg weight	64.8	4.8	-0.06	-0.01	-0.37	-0.08
Shape index	78.0	2.8	+0.99	+0.35	-0.41	-0.14
Shell thickness	0.40	0.03	+0.01	+0.33	-0.01	-0.33
Shell percentage	10.2	0.7	+0.27	+0.34	-0.28	-0.35

The differences suggest that selection on dynamic stiffness would have less effect on egg weight, but lead to rounder egg shape, compared to selection on breaking strength. These relationships will be analyzed in more depth, based on breeding values for all traits of economic significance in different commercial lines while the crack detector is being used routinely in addition to breaking strength. Egg shape may need additional attention in future egg quality evaluation to maintain a desirable shape for commercial table eggs as well as hatching eggs.

Summary and conclusion

The „Crack-Detector“ is a device to measure the dynamic stiffness (K_{dyn}) of egg shells, using the same physical principles as large commercial egg grading stations to sort out eggs with defective shells. The important feature for application in genetic evaluation and selection is that the parameter K_{dyn} is a quantitative measure to predict the probability of breakage based on individual eggs with apparently intact shells from the frequency of vibrations (in response to being hit by a small hammer) and egg weight.

Estimates of genetic parameters summarized in table 2 confirm previous reports by DUNN et al., based on data from the same line three generations earlier. The higher heritability compared to breaking strength (h^2=0.40 vs. 0.10) and a genetic correlation of +0.57 between these two criteria of shell strength suggest that the introduction of Kdyn as additional trait in selection indexes should help to further reduce shell breakage under field conditions. The lower genetic correlation with egg weight

(-0.14 vs. -0.57) will enable breeders to maintain both shell quality and egg weight at a desirable level with less selection pressure compared to selection only on breaking strength.

Follow-up studies will investigate at which age Kdyn should be measured to predict the persistency of shell quality in cross-line progeny of sires selected on a combination of traditional breaking strength and dynamic stiffness.

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Zusammenfassung

Eischalenbeurteilung mit Hilfe des "Crack detector": eine neue Methode zur Verbesserung der Eischalenstabilität

Wiebke Icken, M. Schmutz und R. Preisinger

Ein Ziel der Legehennenzucht ist die Verminderung defekter Eischalen in der Praxis durch eine Verbesserung der Eischalenstabilität. Für die Messung dieses Selektionskriteriums wurde ein neues Gerät, der „Crack Detector" entwickelt, mit dem die Schalenstabilität eines Eies über den Messwert „dynamic stiffness" (K_{dyn}) bestimmt wird. Die Erfassung dieses quantitativen Merkmals erfolgt nach den gleichen physikalischen Prinzipien wie in großen kommerziellen Eiersortieranlagen, die Eier mit Haarrissen und anderen Schalendefekten aussortieren. Ein seitlich am Gerät angebrachtes Mikrofon zeichnet die Frequenz der Schalenvibrationen auf, die durch den Aufprall eines Hämmerchens erzeugt werden. In Verbindung mit dem jeweiligen Eigewicht kann hieraus der entsprechende K_{dyn}-Wert berechnet werden.

Schätzwerte genetischer Parameter sind in Tabelle 2 zusammengefasst. Die Heritabilität für das neue Merkmal der Schalenstabilität (K_{dyn}) ist überraschend hoch (h^2=0.40) im Vergleich zur Bruchfestigkeit (h^2=0.10). Die genetische Korrelation zur Bruchfestigkeit (+0.57) spricht dafür, K_{dyn} als zusätzliches Merkmal bei der Selektion zu berücksichtigen, um den Anteil defekter Eischalen weiter zu verringern. Die im Vergleich zur Bruchfestigkeit weniger enge Beziehung zum Eigewicht erleichtert es dem Züchter, Schalenstabilität und Eigewicht gleichzeitig zu optimieren.

In weiteren Untersuchungen soll gezeigt werden, in welchem Alter das Merkmal K_{dyn} erfasst werden muss, um eine gute Persistenz in der Eischalenqualität zu erreichen. Die Daten sollen von Kreuzungsnachkommen stammen, deren Väter nach einer Kombination aus traditionellen Bruchfestigkeits- und K_{dyn}-Werten selektiert wurden.

Minimizing losses in poultry breeding and production: how breeding companies contribute to poultry welfare

D.K. Flock[1], K. F. Laughlin[2] and J. Bentley[3]

ABSTRACT

The modern poultry industry has a remarkable record in reducing mortality, applying a combination of effective disease control, adequate nutrition, good husbandry and genetic selection. Primary breeders, specialized in the adaptation of layers, broilers and turkeys to changing demands of a global food market, have made three major contributions in the past: (1) eradication of vertically transmitted disease agents such as lymphoid leucosis viruses, mycoplasmas and salmonellae; (2) selection between and within lines for general liveability and specific disease resistance; and (3) dissemination of management recommendations which may help customers to minimize losses at the commercial level. Current focus is on components of liveability which are directly or indirectly linked to poultry welfare: selection against feather pecking and cannibalism in egg-type chickens and selection against leg disorders and heart/lung dysfunction in rapidly growing meat poultry.

Introduction

Extensive poultry keeping, still widely practiced in many countries, often involves high mortality due to diseases, predators, lack of adequate food and water, extreme temperatures and other stress factors. Since the end of World War II, animal agriculture in Europe and other parts of the world has expanded significantly in terms of volume and efficiency. During the past 50 years, priorities of the industry and consumers gradually changed from satisfying basic demand for volume to focus on product quality and food safety in a saturated market. Globalization of food production from farm animals and increasing attention of societies to modern food production in terms of animal welfare, environmental protection and other sustainability criteria are calling for more transparency of breeding and production processes “from farm to fork”.

The European Commission has initiated a project “Code of Good Practice for European Farm Animal Breeding and Reproduction”, in which specialists representing the major farm animal species will develop guidelines for breeding companies to be followed in practice, with the option of certification by independent organizations on a voluntary basis. This Code can also be used in monitoring to what extent breeding companies contribute to the demand of society to minimize unnecessary suffering of animals in intensive production systems.

The term “losses” may be used in different contexts: financial losses due to market prices below production cost, lost productivity (relative to genetic potential) due to suboptimal management, losses due to inadequate product quality (e.g. shell defects; condemnation of carcasses) or death losses during the production period. We will address losses in the broad sense, but focus on mortality, where in some cases numerical data over a long time period are available.

Breeding goals and expectations of society

Breeding goals are defined in general terms for a long time horizon and gradually adapted to take current market demands into account. The general breeding goal for all farm animal species is a balanced performance profile, suitable for efficient production of meat, milk or eggs under the prevailing or expected future conditions. More specifically, egg-type strains are mainly selected for high egg

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output, efficient feed conversion, egg quality as defined by the egg processing industry, retailers and consumers, and adaptability to specified environments, including liveability. Meat-type strains (broilers and turkeys) are selected mainly for rapid weight gain, efficient feed conversion, and high yield of valuable carcass parts as demanded by processing industry and consumers and adaptability to conditions of the industry. In addition, meat strains are being selected for reproductive performance to keep a balance between parent performance and efficient meat production of the commercial cross.

While these breeding goals have served as a useful basis for systematic genetic improvement in the past, animal welfare organizations criticize the practice of intensive selection for “economic” traits which are claimed to be antagonistic to the wellbeing of animals. Instead of selecting for more eggs or more meat in a shorter productive life, animal welfare organisations demand a change to extensive systems, in which the animals can express their “natural” behaviour.

Most people will agree with breeders and producers that mortality and losses due to diseases, stress, inadequate nutrition and/or unsuitable technical environment should be minimized. The question is: to what extent are breeding companies contributing to this goal, and are the methods employed acceptable in terms of bird welfare?

European poultry breeders are actively involved in a project “Code of Good Practice for European Farm Animal Breeding”, in which guidelines will be developed for different farm animals (cattle, pigs, poultry and aquaculture). We are confident that this project will contribute to more transparency of current breeding goals and breeding practices to a wider group of stakeholders.

Selection for general liveability

Examples of successful selection for general disease and stress resistance are difficult to find in the literature. This is because the industry approach is multiple trait selection between and within lines, often without appropriate controls and not designed for publication. However, strain differences consistently observed in the field suggest that some breeders have been more successful than others to develop general liveability. Single trait selection experiments are of little interest for the poultry industry as long as they are based on experimental populations which are not available or not competitive on the market.

Dickerson (1955) presented data from a commercial breeding programme in California, where the concept of exposing the pedigree generation of commercial White Leghorn lines to “field conditions” in several farms and selecting among survivors produced apparently no progress in survivor egg production, while mortality actually increased, from about 20% in the early 1930’s to about 50% twenty years later. The main causes of mortality at that time were respiratory infections (CRD), Marek’s disease (MD) and lymphoid leucosis. Since then, it has become common practice to protect flocks by better hygiene (all-in, all-out management) and vaccination against Marek’s disease and respiratory diseases.

As long as one primary breeder can claim superior liveability in the commercial cross, all other breeders will be under competitive pressure to improve general liveability. This explains why experienced practical geneticists in the industry tend to pay more attention to general liveability than less experienced colleagues who have learned from theory that traits with low heritability and little economic value deserve little weight in the selection index.

Selection for specific disease resistance: Marek’s disease as an example

During the 1960’s, primary breeders of egg-type and meat-type chickens tested extensively for differences between and within lines for Marek’s resistance. Results of a 5-year selection programme, based on “natural exposure” to virus shedders in isolated farms, was reported by Flock et al. (1975) and reviewed by Beaumont et al. (2003) in view of new insights since the time when the experiments were carried out. Mortality during rearing under conditions of MD exposure was reduced by about 20% (35 vs. 55%) in reciprocal crosses. Interestingly, the line segregating for B_{19} and B_{21} did not respond to reciprocal recurrent selection, although the superior resistance of B_{21} known from many publications was later confirmed in this pure line. Another lesson learned from this experiment is that specific disease resistance may have a short life in the commercial world: as soon as MD vaccines became available, the relatively resistant lines were too far behind in egg production (about 2 kg egg mass per hen housed) to have any value for the egg industry.

For some time it was thought that brown-egg strains were less susceptible to Marek's disease than White Leghorns so that selection concentrated on Leghorns. However, as reported by Flock et al. (1992), brown-egg type cockerels may exhibit very high mortality if challenged with a virulent field strain. The search for better protection against MD continues. To enhance genetic resistance against Marek's disease, integrative genomic approaches are being studied (Cheng et al., 2004), which it is hoped will help primary breeders to identify resistance genes in their elite lines without exposing large numbers of birds to the disease.

Another area of ongoing research is to develop better protection against E. coli by genetic resistance and/or farm specific vaccines. E. coli infections have been known as a potential problem in meat-type flocks of broilers and turkeys for some time and are now receiving more attention in connection with the change from cage to floor management of laying hens.

Eradication of diseases: top-down principle

The hierarchical structure of the modern poultry industry has a few dedicated primary breeders supplying parent stock to franchise hatcheries or integrated customers around the world. This structure has permitted the control of vertically transmissible diseases which caused high mortality and depressed productivity of infected birds in former years.

A well known example is lymphoid leucosis, where virus subgroup LL-A was as a major problem in some White Leghorn strains until its eradication from all pedigree stock during the 1980ies and 1990ies. Fast feathering daughters of slow feathering dams are apparently immune tolerant to the LL virus in White Leghorn lines, which meant that the virus had to be eliminated before feather-sexing varieties could be introduced successfully. These varieties are not resistant to LL and can theoretically be re-infected horizontally, e.g. by LL-positive chicks hatching in the same hatchery. Knowing this, primary breeders have eradicated the virus from all lines, and their customers should not allow hatching eggs of unknown source and LL-status in their hatchery.

More recently, a new leucosis virus subgroup, LL-J, appeared in some broiler lines and caused substantial mortality in parent stock and condemnations in broilers before it could be eradicated.

Two other contributions of breeding companies: The eradication of mycoplasmas from chicken and turkey lines contributed significantly to the reduction of respiratory diseases in commercial layers and meat-type poultry, which enhances poultry health and wellbeing significantly. Bio-security and decontamination of feed to minimize the risk of Salmonella infection of breeding stock is primarily seen as a contribution to food safety, but also has correlated positive effects on the health and wellbeing of poultry.

Breeding companies are fully aware of the potential danger of multiplying problems by vertical transmission of disease agents and invest heavily in bio-security to protect their own stock as well as the interests of their customers. Further improvements are possible at the level of commercial egg production, where all-in, all-out management has become industry standard in large units, while many smaller family farms accept a lower health status to assure continuous egg production.

Considering poultry health, efficiency of production and food safety in the global context, it is obvious that breeding companies, as key players in the industry, must cooperate closely with their customers and local veterinary authorities to minimize economic losses, which will automatically contribute to animal welfare in a very practical sense.

Regional bio-security needs to take small flocks of indigenous poultry into account, which are seen as a major risk factor for avian influenza breaks and other infectious diseases.

Adaptation of laying hens to cage and floor management

Laying hens differ in their adaptability to different husbandry systems. About 50 years ago, when the egg industry discovered the advantages of cage management in large units, breeders who tested different strain crosses in cages found that some combinations adapted well, while others were too flighty or otherwise not suited for this system and were subsequently eliminated. Testing at the pedigree level then changed from trap-nesting in traditional floor pens to single bird and multiple bird cages, but grand parents and parents are kept predominantly in floor systems to this day. Following the introduction of MD vaccination, average mortality of commercial layers kept in conventional cages continued to decline to about 5% per year, as documented in a long-term analysis of German random sample tests (Flock and Heil, 2002), but is increasing again with the re-introduction of floor management. Mortality to 66 weeks of age in the 35th North Carolina Layer Performance and Management Test (2003-04) varied between 2.3 and 16.0% in conventional cages with 413 cm² per hen.

Since the EU decided that conventional cages must be phased out by 2012, primary breeders have been paying increased attention to traits with special importance for floor management, i.e. cannibalism, feather pecking and susceptibility to *E. coli*. Iable 1, recent data from two official German random sample testing stations are summarized to illustrate differences in mortality and other characteristics expected when cages are replaced by floor management, with or without beak trimming.

Table 1: Average mortality, egg production and feed conversion of commercial layers in two official German random tests (3 years data)

Station and Management System	Mortality %	Egg Mass kg/HH	Feed Conv. kg/kg
Haus Düsse, conventional cages	5.8	20.35	2.00
Kitzingen, floor, beak trimmed	6.9	18.16	2.28
Kitzingen, floor, untrimmed	17.7	17.03	2.46

Based on the figures documented in table 1, we can project what the change from conventional cages to floor pens may cost (in terms of more mortality and more feed) to satisfy the current demand for eggs in Europe, depending on whether beak trimming is allowed or not.

The European egg industry will reduce these losses in several ways: a substantial part of egg production may move to countries where cages are still allowed, beak trimming and/or light control practices may have to be applied in floor systems, and egg producers have to continue a learning process, while primary breeders try to improve adaptability to floor management - selecting mainly against cannibalism and feather pecking, but also against mortality due to *E. coli*.

Taylor and Hurnik (1996) compared the productivity of hens between battery cages and an aviary, based on 763 hens of one commercial White Leghorn strain. In this experiment, the caged hens were beak trimmed at 22 weeks of age, following an outbreak of cannibalism, whereas this procedure was not necessary in the aviary at any time during the 3-year study. These authors conclude from the literature: “mortality rates have been reported elsewhere to be higher in battery cages than in alternative systems and vice versa”.

Muir (2003) describes results of a selection experiment, in which the mortality of a White Leghorn line was reduced from 68% to 8.8% within six generations. Similar approaches have been used by commercial breeders for a number of years, but their results are less spectacular, because most commercial strains have a lower initial incidence of cannibalism and selection for multiple objectives requires more time to change additional traits.

Important differences exist between strain crosses with regard to mortality, feather loss and their response to beak trimming to control these problems, as demonstrated with results of the German random sample test at Kitzingen (Damme, 1999). Since random sample tests have all but disappeared, egg producers must depend on information from other sources. We assume that all primary breeders of laying hens are currently selecting for these traits, depending on their competitive position in the market. The response will differ, depending on the genetic parameters of the lines and actual selection pressure.

Adaptation of broilers to commercial environments

Today's broiler industry has its origin in the seasonal rearing of cockerels of egg-type or dual purpose breeds for meat. Per capita consumption of chicken meat was therefore about 1 kg from "soup hens" and even less from young cockerels. With increasing demand for meat from young chickens, breeds with good growth rate were selected for more rapid weight gain and other traits contributing to efficient broiler meat production.

In a review of the history of the US broiler industry, Gordon (1974) gives the estimates of broiler performance between 1923 and 1973 shown in table 2. The decrease in mortality is mainly due to better control of diseases and improved husbandry. Family selection for liveability and eradication of egg transmitted diseases at the pedigree level may have contributed to the reduction of mortality in the past, but the main contributing factors were probably better general hygiene, vaccination against common field infections, experience of successful farmers and reduced disease risk during a shorter life.

Table 2: Typical broiler performance in the USA (from Gordon, 1974 and Havenstein et al., 2003)

Year	Weeks of age when sold	Live weight kg	Feed efficiency kg feed/weight	Mortality %
1923	16.0	1.00	4.7	18.0
1933	14.0	1.23	4.4	14.0
1943	12.0	1.36	4.0	10.0
1963	9.5	1.59	2.4	5.7
1973	8.5	1.77	2.0	2.7
1957	12.0	1.43	3.84	4.7
2001	6.0	2.67	1.63	3.6

The data from Havenstein et al. (2003) shown in the last two lines of table 2 are based on a comparison of current commercial broilers (Ross 308) with an unselected control line representing genetic potential in 1957, using feeding regimes typical for 1957 and 2001. The modern broiler reached almost twice the live weight on 20% less feed in half the time. Comparing growth rate and feed efficiency at different ages and different weights may not be satisfactory from a statistical point of view, but the conclusion is: to produce live broilers for current consumption with the genotypes available in 1957, the farm capacity would have to be doubled and 4.4 times as much feed would be needed to produce the same volume. The figures are even more dramatic if based on edible meat, because carcass yield and percentage valuable parts were improved at the same time.

Improved feed efficiency is a major contribution of the broiler industry to sustainable production of animal protein for human consumption: more meat from less feed saves resources (land, feed, water, energy), and reduces N and P emissions.

A critical analysis of changes in liveability requires larger numbers and can only be roughly estimated from the data of Havenstein et al., because replicates were sacrificed for carcass analysis between 6 and 12 weeks (the figure of 4.7% mortality in the control line shown in table 2 was reported for 8 weeks on the 1957 ration; in the remaining replicates, cumulative mortality to 12 weeks was lower). Cumulative mortality to 42 days of age was 3.6% across both sexes and rations in the modern broiler type, compared to only 2.1% in the 1957 control line. Although mortality to a given age apparently increased, by extrapolation, a much greater number of birds would die if the same total weight of live broilers were produced from the unselected 1957 control line.

Cumulative mortality and the incidence of leg disorders depend on the specific testing conditions. In their 2001 comparison, Havenstein et al. found about half the mortality compared to an earlier comparison in 1991, both in the commercial broiler (Arbor Acres) and in the control line. They concluded that most of the improvement was due to an improved growing environment. Results of this recent study were not available when Rauw et al. (1998) reviewed the undesirable side effects of selection for high production efficiency, but strongly suggest that selection against leg defects combined with improved management has actually reduced the rate and severity of leg problems in commercial broilers.

Studying growth curves of commercial male broilers (Cobb 500 and Shaver Starbro), Goliomytis et al. (2003) found very high mortality (mainly due to leg problems), increasing especially after 10 weeks of age to almost 50% at 22 weeks of age. However, if such results were typical for the industry, these breeds would no longer be placed. These results highlight some of the problems in interpreting small scale trials and extrapolating the results to commercial practice.

Broiler breeders are working to reduce further, over-all broiler mortality, leg disorders and susceptibility to heart/lung insufficiency. At the pedigree level, broiler lines are usually “broilerized”, i.e. fed ad libitum with concentrated broiler feed, so that weaknesses can be detected and incorporated within family selection. McKay et al. (2002) reported the results of a large survey of leg health in broilers in the UK by The British Poultry Council (Pfeiffer and Dall’ Aqua, 2002), in which the gait score of 37,224 broilers was assessed by trained veterinarians and stockmen. Over a period of 6 years (1994 to 2000), the prevalence of leg defects (gait scores over 2) averaged less than 3%, decreased with time and reached 1.87% in the last observation period. More surveys of this kind would be desirable to monitor trends in welfare related traits of all farm animals under commercial conditions.

To utilize the growth potential of fast growing broiler strains to produce higher body weights, management and nutrition must be adapted to minimize losses. *Ad libitum* feeding of high density rations would not be economical and lead to justified criticism on welfare grounds. Management recommendations broiler growers obtained from their feed and chick supplier help in minimizing losses to slaughter age. For example, fine-tuning chick starter rations and correct temperature help to optimize early growth rate and reduce mortality due to heart/circulatory failure; appropriate lighting programmes and distance between feeders and drinkers help to minimize leg problems by inducing the chick’s activity and mobility.

No practical alternative to controlled feeding of broiler breeders is available at the present time, and it must be understood that *ad libitum* feeding of these lines would compromise their wellbeing even more. Management recommendations and practices are designed to ensure that maintenance requirements are always met and growth continues at a reduced yet controlled rate.

Slower growing meat lines are being offered by breeders to the market and are being used for certified (e.g. “Label Rouge”) broiler production in some countries, but their market potential is limited by cost and other constraints. In particular, their less efficient feed conversion is not compatible with two other sustainability objectives: to minimize waste of resources (feed, water, energy, land) and to reduce pollution of the environment with N and P emissions. As can be learned from French producers of “label” broilers, the higher production cost can only be recovered with a system of contracts and strictly limited volume.

Adaptation of turkeys to commercial environments

Breeding goals and selection procedures for turkeys are similar to those for meat-type chickens: male lines are selected mainly for efficient weight gain and high carcass yield and walking ability, while female lines are also selected for reproductive efficiency when fed ad libitum on appropriate feed programmes. At the parent level, artificial insemination is commonly used to achieve acceptable fertility rates. Animal welfare groups argue that this is a consequence of recent breeding for extreme breast meat yield in male lines, which are no longer able to mate naturally. Actually, artificial insemination in the 1960s pre-dates both the development of the commercial turkey industry and commercial turkey breeding in many European countries. The alternative practical viewpoint is that AI, providing it is undertaken by suitably trained and supervised persons handling the birds, enhances welfare in all turkey lines by eliminating injuries to the females during mating. These occur because males are both aggressive during mating and heavier, the latter being due to either within-line sexual dimorphism in pure line matings or significant line differences in body weights in commercial crossbred matings. Reliable field data on trends in live turkey production in Europe are difficult to find. Surveys of the kind reported by the British Poultry Council for broilers would be welcome to provide objective data on which an informed discussion can take place. Data recently published by Ferket (2002) indicate that growth rate of Large White toms to 18 weeks of age increased almost linearly between 1966 and 2002 by 194g per year, while Large White hens gained 77g more each year to 14 weeks of age. To reach typical market weights of 15.9 kg (35 lbs.) for toms and 7.3kg (16 lbs.) for hens, it took 220 and 147 days in 1966 vs. 136 and 99 days in 2002. Feed consumption per kg live weight did not change significantly during the last 30 years, if calculated on an age constant basis. Unfortunately, these long term statistics do not contain figures on liveability. Table 3 shows recent data on live production and liveability from key countries in North America and Europe from the same author.

Table 3: Average performance of commercial Large White turkeys by country

Country	Age days	Live weight kg	Daily Gain g/day	Feed/ Gain kg/kg	Condem nations Pct.	Live-ability Pct.	Sample size Mio
Toms							
USA	133.7	15.59	116	2.71	2.84	85.4	45.50
Germany/NL	145.1	19.09	131	2.85	4.27	88.6	21.30
Hens							
USA	102.4	7.50	74	2.34	1.10	91.1	59.50
Germany/NL	110.6	9.55	86	2.79	2.46	95.1	13.70

Data from Canada, Ireland and Italy are omitted here, because the sample size (less than 1 million turkeys) is considered inadequate. Comparing results from North America and Europe, it is interesting to note that liveability is better in Germany and The Netherlands, despite higher body weight. Whether higher condemnation rates reflect true differences or different grading standards cannot be answered from these data.

The list of problems Ferket received from the respondents of his survey included early mortality, coronavirus, pneumovirus, E. coli infections, airsacculitis, Mycoplasma meleagridis (passed on from breeders), mild cannibalism and aggressive behaviour, leg problems, flushing (enteritis), high incidence of late mortality and adverse weather conditions.

In a review of current breeding goals for anticipated market trends, Bentley (2002) emphasized the need for turkey-specific research to investigate the genetic basis of walking ability and injurious pecking. Selection for liveability is practiced on the basis of individual and family information, with special emphasis on walking ability and deportment at maturity in males and females while genetic control of aggressive pecking in males requires further refinement. Sometimes lines are replaced or added to the range of products offered by the breeder, in which case the relative merits of the new line are of special interest. Roberson et al. (2004) compared existing and new commercial turkey crosses, mainly on growth performance and carcass composition. In the context of the present review, it is interesting to note that total mortality to 19 weeks of age varied between 4.1 and 14.5%, mortality due to round heart disease between 1.5 and 9.3%, mortality and culling due to severe leg problems between 0.5 and 2.1%. Differences in mortality found in samples of 200 to 400 turkeys in a controlled comparison should not be extrapolated to field conditions, but they suggest that important differences may exist.

Consumer attention is expected to focus not only on high quality meat at competitive prices, but also on production under bird-friendly conditions. Beak trimming of day-old poults and control of light intensity are effective preventive measures, but subject to criticism under welfare considerations. Selection against aggressive pecking and for walking ability at the pedigree level assures that individuals with obvious defects or high frequency of defects in the family are excluded from reproduction.

Adaptation to variable market requirements is partly achieved by growing females and males of different strain crosses to different ages and corresponding live weights. The economic importance of liveability increases with the age of commercial turkeys. Breeders focus on reduction of losses in males due to aggression, which tends to increase as they approach sexual maturity.

Discussion

Poultry breeding companies can look back at an impressive record of improving the efficiency of egg and poultry meat production, which has helped to make these products affordable for more consumers world-wide. Mortality and loss of productivity due to infectious diseases have been reduced with a combination of genetic selection, poultry health research and development of management recommendations for commercial producers. From information disseminated by animal welfare organizations, the general public may get the impression that increased efficiency has been achieved at the expense of animal welfare. A balanced presentation of industry practices should include the positive developments described here.

In answering demands of the European society, the breeding industry is developing standards which take perceived needs of the animals in terms of animal welfare into account. If more transparency of the production chain is demanded, breeders may have to explain in non-technical language why free range management is incompatible with bio-security for breeding stock and why “challenging” test flocks (relatives of pedigree stock in an environment with maximal bio-security) are being exposed to sub-optimal conditions reflecting the range of conditions encountered in practice. This should not be confused with “animal experiments”.

To enhance genetic resistance against Marek’s disease, integrative genomic approaches are being studied (Cheng et al., 2004), which hopefully will help primary breeders to identify resistance genes in their elite lines without exposing large numbers of birds to the disease. This could be a significant contribution to poultry welfare in the whole production chain from breeder to producer. Similar arguments hold for any other disease where genetic resistance is established and selection strategies can be formulated. However, relationships between “markers” and actual resistance need to be verified repeatedly in each specific line or cross, i.e. the availability of genetic markers will not completely eliminate the need for exposure to disease agents under controlled conditions.

Communication with the general public will remain a difficult challenge for the farm animal industry. Poultry breeding is part of the global food chain, and breeding goals have to be defined according to expected demands of consumers and those who produce and market animal products. Increasing attention to “sustainability” in farm animal breeding includes the objective to produce under conditions which meet ethical standards of the society. Most consumers in Europe buy food on price, safety and perceived quality, whereas animal welfare groups focus on the “needs” or “rights” of animals, ignoring the fact that many consumers have a limited food budget.

Animal welfare organizations in Europe advocate the return to extensive production systems, but only a minority of consumers is prepared to pay a higher price for these products. For the dialogue between the farm animal industry and consumer organizations to be productive, it is necessary to communicate in more depth what breeders are currently doing, what changes are possible and how long it takes for desirable genetic changes to have an impact.

Some ethicists advocate a vegetarian lifestyle in order to stop the use of animals for food production (Singer, 1975). The animal industry is focused on supplying consumers with high quality products at competitive prices, but would be ill advised to ignore justified criticisms of non-consumers of animal products. We are actually dealing with two issues: the perceived "needs" or "rights" of animals, but also the ethical standards and emotions of all people.

Animal welfare organizations in Europe criticize the practice of killing day-old cockerels of egg-type chickens, for which no practical alternative exists yet (Klein et al., 2003). Research to identify alternative solutions continues. Human emotions and ethical objections against killing may be stronger when cute, fluffy chicks rather than adult cockerels or spent hens are involved. Before the advent of more efficient poultry meat production from broilers and turkeys, a cockerel was a rare delicacy few people could afford. Unless a significant number of consumers demands meat from egg-type cockerels, they will not be raised to market weight.

As recently pointed out by Savory (2004), the politicians who make the decisions, those responsible for formulating animal welfare standards, and those responsible for enforcing them have to balance between satisfying public opinion on the one hand and not compromizing commercial interests too much on the other hand. The European poultry industry and the breeders who supply it are fully aware of society demands and will continue to look for solutions which further improve poultry wellbeing within a well informed, transparent and rational debate.

References

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Zusammenfassung

Minimierung von Verlusten in der Geflügelzucht und -produktion: wie Zuchtfirmen zum Tierschutz beitragen

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In der modernen Geflügelwirtschaft ist durch wirksame Krankheitsprophylaxe, bedarfsgerechte Ernährung, gutes allgemeines Management und genetische Selektion auf Krankheits- und Stressresistenz eine bemerkenswerte Verringerung der Tierverluste erreicht worden. Basiszüchter, die sich auf die Anpassung von Legehennen, Broilern und Puten an wechselnde Anforderungen im Weltmarkt für Geflügelprodukte spezialisiert haben, können auf drei Beiträge hinweisen: (1) Eradikation vertikal übertragbarer Krankheitserreger wie lymphoide Leukose, Mykoplasmen und Salmonellen; (2) Selektion zwischen und innerhalb Linien auf allgemeine Lebensfähigkeit und spezifische Krankheitsresistenz; und (3) Ausarbeitung von Managementprogrammen und Lehrgänge für Kunden, um die Verlustraten in der Praxis zu minimieren. Gegenwärtig konzentrieren sich züchterische Bemühungen auf Komponenten der Überlebensrate, die direkt oder indirekt mit Tierschutz zu tun haben: Selektion gegen Federpicken und Kannibalismus bei Legehennen und gegen Beinschäden und Dysfunktion des Herz-/Kreislaufsystems bei schnell wachsenden Broilern und Puten.