BIRD-e -The Poultry E-Feeding System: Basis and Applications

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BIRD-e – Le système d'alimentation électronique pour volaille : fondements et applications

Eva Pampouille[1], Amandine Mika[1], Jérémy Bernard[2], Elodie Guettier[3], Quentin Berger[3], Isabelle Bouvarel[1], Sandrine Grasteau[3]
[1]Institut Technique de l'Aviculture, 37380 Nouzilly, France
[2]PEAT, INRAE, 37380 Nouzilly, France
[3]BOA, INRAE, Université de Tours, 37380 Nouzilly, France

Abstract

Until now, individual measurements of feed efficiency and feeding behavior have been performed on animals raised alone and in cages, but it has several drawbacks, in particular the absence of social interactions and the limitation of movements, which leads to an experimental bias, as conditions are not representative of farming conditions.
The electronic feeder BIRD-e (Bird Individual Ration Dispenser-electronic) developed by INRAE and ITAVI allows to overcome these constraints with automatic recording of individual measurements of feed consumption and poultry weight raised on the ground and in groups.
BIRD-e has eight feed access points, each equipped with two scales (one for feed, one for birds) and a detection antenna. Each chick is fitted with an electronic identification chip so that each visit to the feeder is recorded. Each station can record data from 100 to 120 animals raised on the ground, without human intervention and without penalizing their growth.
Therefore, individualized measurements of weight and feed consumption are obtained continuously. It is also possible to collect information on feeding behavior: time spent to eat, time between two meals, etc.
The expected benefits of this technology are at first progress in genetic selection, by integrating criteria of feeding behavior and by being more efficient on feed efficiency. On the nutritional aspect, this innovative tool allows to study the impacts of feed composition and technology on the feeding behavior of birds and their performance. This device is already used in research programs and could be used for partnership research within a year.

Résumé

Introduction

Controlling production costs and animal welfare are important factors for livestock keepers. Feed accounts for about 70% of the production cost in poultry. The feed conversion ratio (FCR), which is the ratio of food consumption to meat or egg production, is an important criterion for the profitability of these farms. It is also an indicator of the environmental impact of production. For example, the reduction of 10% in FCR allows a reduction in the production cost of live chicken of about 6%, but also a reduction in the environmental impact of 12% for nitrogen excretion and 17 % for phosphorus (De Verdal et al., 2011). Until now, individual measurements of feed efficiency and feeding behavior have been performed on animals raised alone and in cages, but it has several drawbacks, in particular the absence of social interactions with congeners and the limitation of movements, which leads to an experimental bias, as conditions are not representative of farming conditions. The bias is particularly important in the case of alternative productions such as Label Rouge or organic chickens. In addition, there is a need of individual data for geneticists to progress in genetic selection, by integrating criteria of feeding behavior and by being more efficient on feed efficiency. For nutritionist, access to individual data could allows to study the impacts of feed composition and technology on the feeding behavior of birds and their performance. Therefore, work had been initiated in 2005 by INRAe to reflect on the development of a tool to measure individual feed consumption of broilers. In 2012, an invention patent was filed. Since, various improvements have been made to the feeder, with the development of electronic part, the recording and processing of data as well as the ergonomics and materials used, and the addition of animal weighing. Finally, the electronic feeder BIRD-e (Bird Individual Ration Dispenser-electronic) developed by INRAE and ITAVI allows to overcome these constraints with automatic recording of individual measurements of feed consumption and poultry weight raised on the ground and in groups. Therefore, the purpose of this paper will be to briefly describe the electronic feeder and its utilization, and give an example of application.

Description of the electronic feeder

BIRD-e has a circular shape with adjustable feet allowing the level and stability of the automaton. A cylindrical PVC outer shell protects the internal elements. The interior assembly is vertically mobile thanks to an electric column fixed to the base, in order to adapt the feeder height to the animals size.

The feeder is equipped with eight feed access points, each equipped with a scale and a detection antenna (Figure 1). 100 to 120 animals can be placed with one feeder without causing competition.

Food distribution is ensured by eight independent columns (1 column for each access). Each column has its own load cell. The measuring capacity of the load cells for the feed is 10 Kg. Each column has a storage volume of 5.6 dm3 and can fill approximately 3 Kg of feed. Each column can be filled with a different food. The lower part of the feed columns is the feed access for the animals. To avoid wastage, the feed access is covered with a transparent cover through which the animal pokes its head to eat.

Animals are weighed using interchangeable trays according to the animals growth: they are clipped onto the animal scale in the axis of the eight accesses. Each tray has its own scale. The measuring capacity of the load cells for the animal is 30 Kg.

The RFID antennas are fixed on the feeder, at the entrance of each access. They are adjustable in height, and in the axial position by means of the sliding support and its knurled knob. This system allows the antenna to be positioned as close as possible to the animal's chip all along the rearing period.

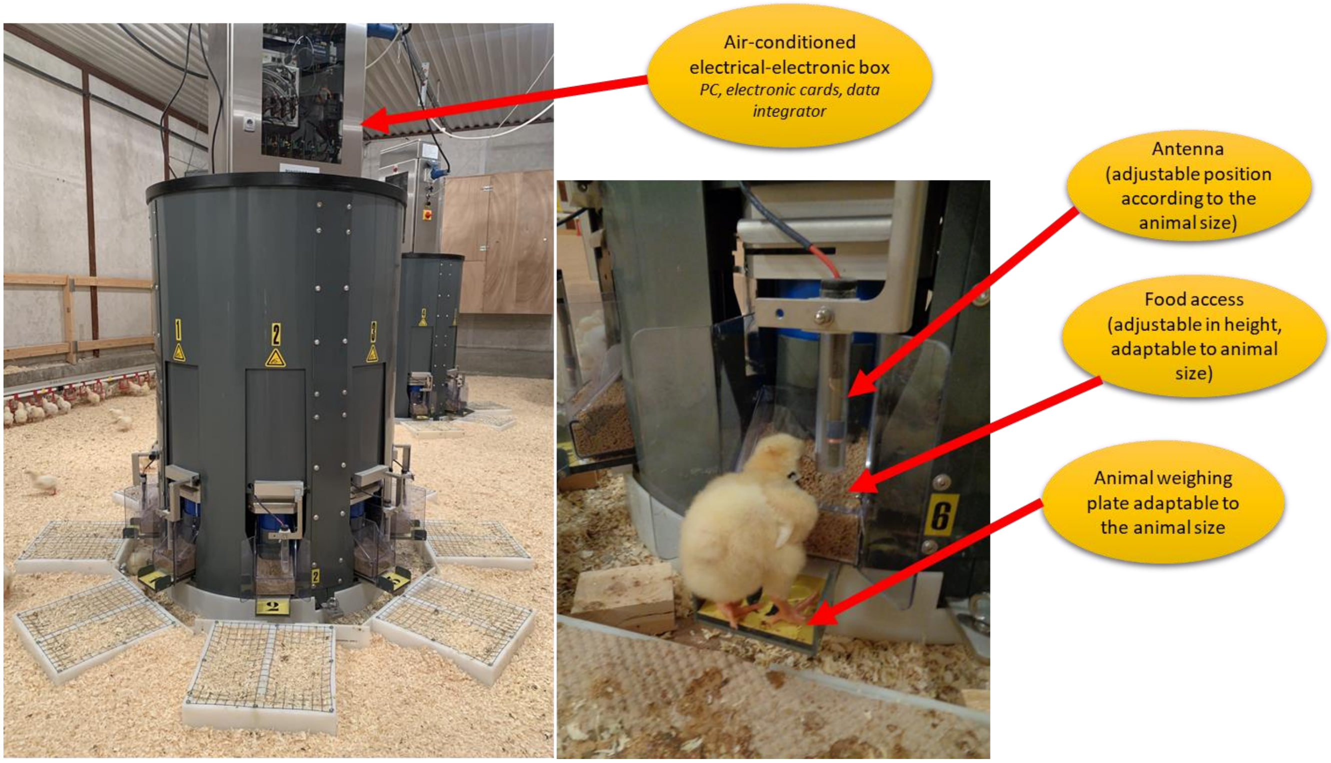

Figure 1. Description of BIRD-e, the electronic feeder for poultry

Operation of the electronic feeder and data collected

When they arrive in the barn, each animals are equipped with an RFID (Radio Frequency Identification) electronic chip attached to the base of the neck for individual identification (Figure 2).

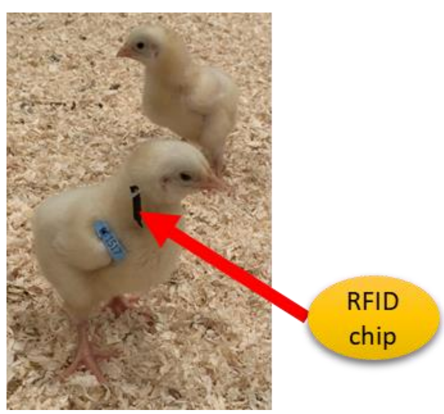

Figure 2. RFID chip attached to the base of the neck for individual identification.

When the animal comes to eat, it climbs onto the dedicated animal tray and the chip is identified by the electronic antenna attached just above. Each antenna is connected to an electronic card which transmits all of the identification data to a data acquisition system (PMX), then stored in an industrial computer. All computer and electronic equipment is grouped together in the electrical cabinet positioned above the feeder. Thus, as soon as an animal eats, its chip is detected and the amount of food ingested as well as its weight are recorded.

Individualized measurements of weight and feed consumption (and therefore feed efficiency) are obtained continuously and at high speed. Each time an animal passes the stage, the chip is detected by the antenna. The identification data is recorded in a first file with the following elements: "Date - Time - Feeder number - Access number - Identification number". The animal weight is recordes every second since an animal id detected. A second data file is generated and contains, for each visit of the animal to the feeder, the "Date - Number of the feeder - Access number - Time of visit start - Time of visit end - Average weight of the animal during the visit ". The feed weight in each of the feed columns is recorded in real time, second by second, whether an animal is present or not, thanks to the scales attached to each feed column. The file obtained contains one data item per second and per access and the following information is entered: "Date - Time - Feeder number - Access number - Food weight".
The data acquisition system synchronizes the data from the eight access and then transmits it to the central computer which stores it and then exports it to a server.
An algorithm for calculating feed consumption for each visit has been developed by determining meal start and end times as well as access weight at the start and the end of the visit. It makes it possible to determine, for a defined meal, the total quantity of feed consumed per animal. By adding all the daily meals of a given animal, it is then possible to have access to the quantity of feed ingested each day.

In addition to animal performance data (weight, feed consumption, feed efficiency), the BIRD-e feeder provides access to new data as animal feeding behavior. Then, it is possible to know, for each animal, the number of meals made in a day, the time interval between two meals, the average duration of a meal, etc. This opens up new perspectives for future nutrition trials.

Example of application: Study of the interaction between genotype and diet for consumption, eating behavior and feed conversion ratio

In this study, we compared a fast (Ross 308) and a slow-growing (French “Label Rouge” LR production) chicken genotype receiving two different diets. Birds of the two genotypes were reared separately and at different period. The LR line was reared until 12 weeks, according to “Label Rouge” rearing practices, and the standard line until 5 weeks. Each genotype received two different diets: a corn-soy diet, as a control (Control) and an alternative diet (Alternative) containing more wheat and local rich-protein feedstuffs as sunflower meal and rapeseed meal, and less soybean meal than the control diet. On arrival, each animal were fitted with an RFID chip for individual identification and were randomly distributed in 2 pens comprising 40 animals per diet, each equipped with an electronic half-feeder (4 access per pen). Daily body weight and feed consumption of each animals were recorded according to BIRD-e feeder, as well as feeding behavior.

For standard chickens, the growing rate and the feed consumption between animals receiving the control diet and the alternative diet were similar all along the rearing period (Figure 3 and 4).

However, from D35, the LR animals which received the alternative diet had a higher growth rate and feed consumption than the animals which received the control diet.

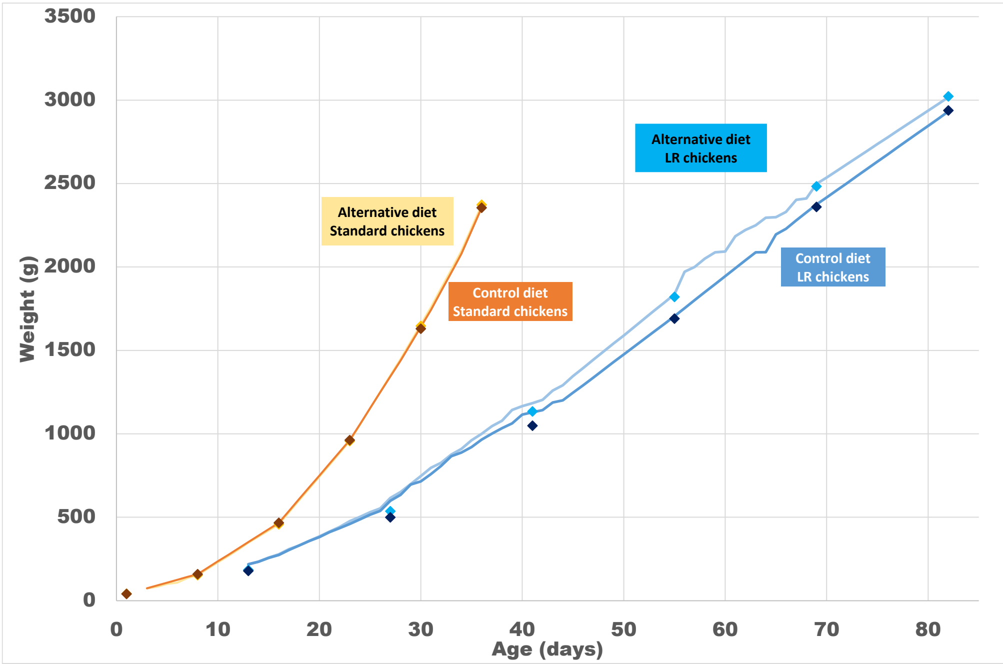

Figure 3. Growing rate of animals from two genotypes and receiving two different diets.

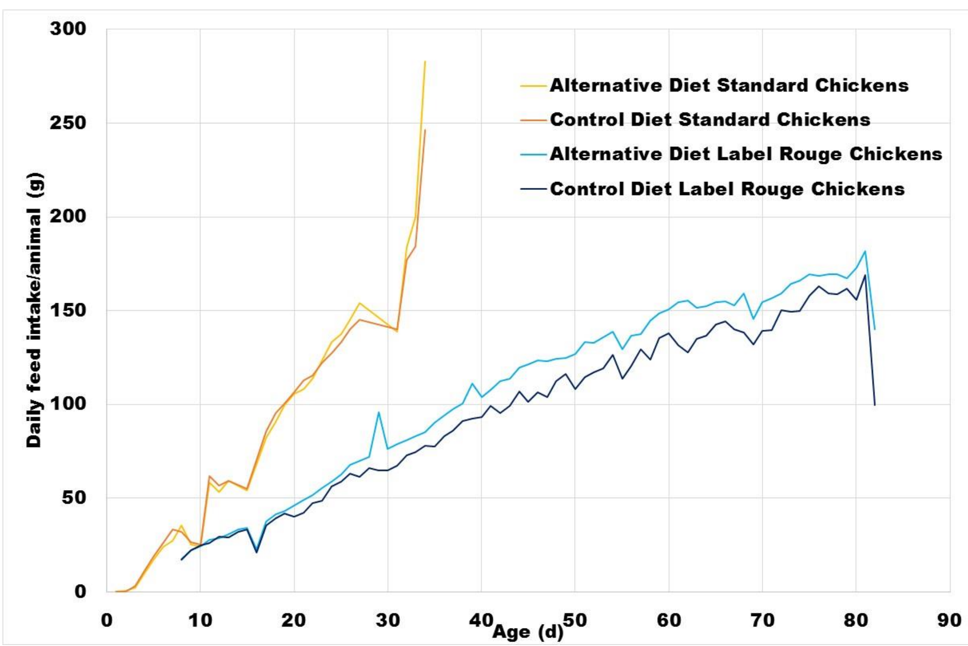

Figure 4. Feed consumption of animals from two genotypes and receiving two different diets.

Regarding the feeding behavior, in general, the LR and standard animals have on average the same number of meals per day except for the standard animals with the control diet where a high mean number of meal was observed (Figure 5). However, a significant different of mean meal duration was observed between the two genotypes. Standard animals have much longer meals than LR animals. In LR genotype, no difference was observed on this criterion between diet. However, in standard genotype, animals with alternative diet have longer meals than animals on the control diet.

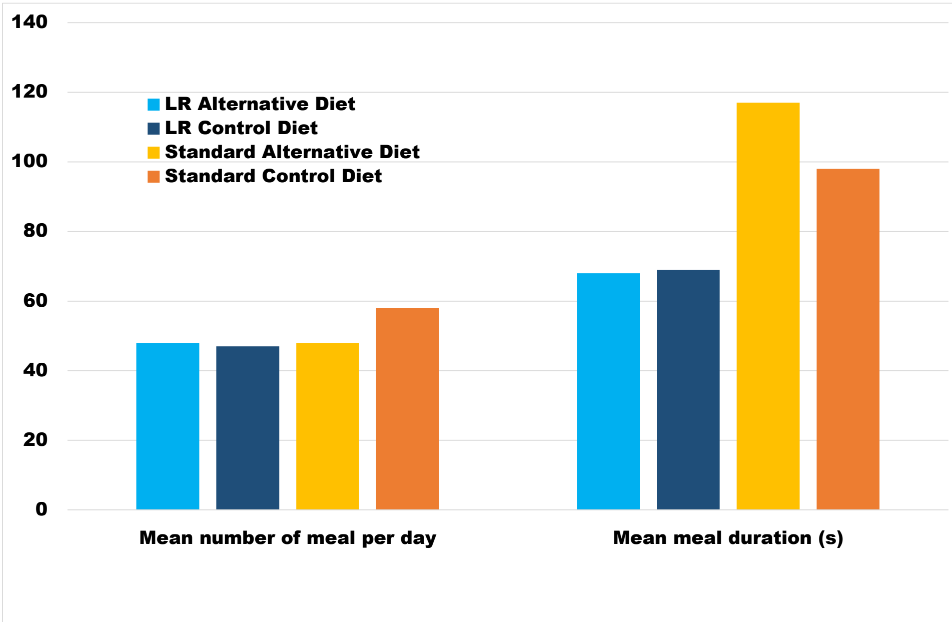

Figure 5. Feeding behavior of animals from two genotypes and receiving two different diets.

With the current system, it is possible to carry out experiments on poultry, in farming conditions close to the field (on the ground and in groups) and to collect individual measurements of food consumption and animal weighing. These data are recorded throughout the breeding period. Each automaton is suitable for 80 to 100 animals. With the six machines available today, it is possible to monitor the consumption and growth of 600 animals individually, which increases the statistical power of the tests carried out. The BIRD-e automatic consumption machine represents a real innovation for research and offers new perspectives around genetic selection and animal feed. This automaton makes it possible to experiment without altering the behavior and well-being of poultry while respecting the principle of 3Rs since its use makes it possible to reduce the number of animals used for scientific purposes. The impact of this technology is expected progress in genetic selection, by integrating criteria of feeding behavior and by being more efficient on feed efficiency. On the nutritional aspect, this innovative tool makes it possible to study the impacts of feed composition and technology on the feeding behavior of birds and on their performance. The device is already used by INRAe and ITAVI for their own research programs. It could be used for a research partnership within a year.

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