University of California

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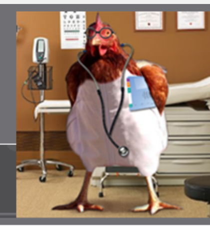
Edition 8



POULTRY PONDERINGS

A QUARTERLY NEWSLETTER SUMMARIZING POULTRY RELATED WORK AT UC

Producing Black Soldier Fly Larvae as Supplemental Feed for Small Scale Poultry Farms

David Barraza, Marianelly Lopez, Emily Quan, Sara Wat, Lisa Wolbert

The cost of feed is a significant burden for many small-scale poultry farmers. Specialized feeds that meet the nutritional criteria needed for pasture-raised poultry are not commercially available, and the customized production of such feeds is not financially feasible at a small scale. We designed a system in which we redirect organic waste to cultivate *Hermetia illucens*, commonly known as the black soldier fly larvae (BSFL), which are a high source of protein. Our prototype system uses a compartmentalized three-part bioreactor: ensiling, cultivating, and harvesting, to manage the BSFL life cycle from beginning to end.

Fly Development

The *Hermetia illucens* life cycle consists of five stages. The duration of each stage, (Table 1) is critical for determining the length of each step of the cultivating process. For the purposes of this project, harvesting occurs once the BSFL are in the pupae state, just before turning into adult flies. At this stage they have the highest protein content. BSFL must be fed and managed over a period of 30 to 40 days.

Engineering students Emily Quan, Lisa Wolbert, Sara Wat, Marianelly Lopez and David Barraza with a fabricated prototype of the cultivator.

The Feedstock Component

Our system seen in the photo to your right, begins by using an ensiling area to process organic waste. Ensiling occurs when organic waste is fermented by anaerobic bacteria, reducing the pH level and killing pathogens. This reduces the potential for hens that are feeding on the larvae to contract pathogens or diseases. To ensile the organic material, we compress the organic waste in a tightly sealed area, reducing oxygen levels and bringing the material to a pH of 6. *Continued on next page…*

PLEASE CONTACT MAURICE PITESKY AT MEPITESKY@UCDAVIS.EDU OR 530-752-3215 WITH QUESTIONS OR COMMENTS

Ensiling the organic mixture is an essential part of our design because it is the most energy efficient method for reducing pathogens in the feedstock. Because the BSFL feed on a large variety of organic waste, we also conducted tests to identify the feed mixture by incorporating on-farm residues that would optimize larval growth. Chicken manure with rice hulls, green material, and water were used as the main ingredients in the mixture. In our testing, we found that optimal BSFL growth is with an ensiled mixture of 60% green material and 40% chicken manure with an overall moisture content of 60%.

The Cultivator Component

Once the feedstock is ensiled, the material is pushed into the cultivator and the BSFL are added into the feedstock. In order to determine the amount of larvae to add to a given volume of feedstock, we calculated a mass balance. Because BSFL bury themselves in up to six inches of waste, growth rates, yield coefficient and larval inoculation density were calculated. From these calculations, It was determined that larvae could consume 21,600 grams dry weight organic waste in 7.15 days.

Table 1. Duration of each stage in the black soldier fly life cycle.

State	Size (mm)	Color	Picture	Duration (days)
1 instar	5	White/ yellow		15
2 instar	12	Light brown		15
3 instar	19	Dark brown		8
Pupa	19	Dark brown		10
Fly	20	Black		7

The Harvester Component

When ready to pupate, the BSFL seek dry and light environments. Knowing this, we constructed a ramp inside of the bioreactor, opposite of the ensiler, at an angle of 30° from the ground. This ramp leads to an open slot connected to a transparent container, the harvester, which is affixed to the outside of the bioreactor. This container lets in light, motivating the BSFL migration. Once the BSFL crawl up the ramp and through the slit, they are captured in the clear box, which can be easily removed by the farmer to mix the BSFL into their poultry feed.

Future Research

We are currently testing our 3-component design. Our current prototype is shown in photo. Additional research will be required to further develop the procedures and the prototype. A new design could incorporate an area for some larvae to breed and produce eggs, thus continuing the life cycle. Temperature and pH sensors would also be advantageous in order to better track the environment for the larvae.

This research is part of the UC Davis Pastured Poultry Farm project which is intended to focus research, innovation and outreach toward non-conventional commercial poultry production. More information about the UCD project can be found by “Googling” “UC Davis Pastured Poultry Farm.”

Keel Bone Damage in Laying Hens in Enriched Colony Cages

Sydney Baker and Maja Makagon, Department of Animal Science, UC Davis

Keel bone damage, defined as a deviation or fracture of the keel, has been associated with decreased egg production, egg quality and carcass value, and increased mortality rates. Published data suggest that keel bone damage may affect nearly 40% of hens housed in an enriched colony system. Funded by the Egg Industry Center (EIC) and in collaboration with Dr. Darrin Karcher (Michigan State University) and Dr. Michael Toscano (University of Bern, Switzerland) we are investigating the risk factors associated with keel bone damage sustained by hens housed in enriched colony systems. We are using hen mounted tri-axial accelerometers and video data to identify the exact moment when hens experience significant impacts at the keel (measured as combined acceleration, g-units), and the behaviors and locations of the hens at the time of impact. Data is being collected over two three week periods within a flock cycle. Changes to the integrity of the keel bone over the course of each 3 week period is evaluated through palpation and CT scan. Combining the impact data, behavioral observations, and CT data will allow us to model risk factors associated with the development of deviations and fractures of the keel bone. This information will serve as a foundation for future investigations into management approaches and cage designs aimed at minimizing the incidence of keel bone damage among hens housed in enriched colony systems

Image of keel bone provided by the Karcher Lab

Highly Pathogenic Influenza Viruses Affecting the U.S Poultry Industry and their Persistence

Rodrigo Gallardo[1], Beate Crossley[2], Rudiger Hauck[1] and Daniel Rejmanek[2], School of Veterinary Medicine, UC Davis[1], California Animal Health and Food Safety Lab[2]

The last highly pathogenic (HP) avian influenza (AI) outbreak in the U.S. decimated the national poultry industry. The reason for the extent of the outbreak is not clearly understood. While we know a lot about the virus and its cycle in the environment including the carriers and their migration routes, we lack knowledge about the cycling and persistence of these pathogens inside the poultry premises. A collaborative effort between CAHFS and the School of Veterinary Medicine has been investigating how low (LP) and highly pathogenic avian influenza persists and the

continued on next pg.

effectiveness of control measures such as footbaths. This investigation has concluded that HPAI is more persistent (up to 48hrs) in bedding material from broilers and turkeys and layer feces (up to 96 hrs) than LPAI (12 hrs in all organic material). Footbaths (Quat and Phenol+Glut based) reduce but do not eliminate AI viral particles in boots confirming that footbaths are only a part of a biosecurity strategy. This team of researchers is currently looking for funding to understand the basis of the increased persistence and if litter treatments limit the presence of live virus in bedding material.

Prevalence of *Salmonella* in Backyard Chickens

Alex Moreo and Maurice Pitesky , UC Davis and UC Davis School of Veterinary Medicine-Cooperative Extension

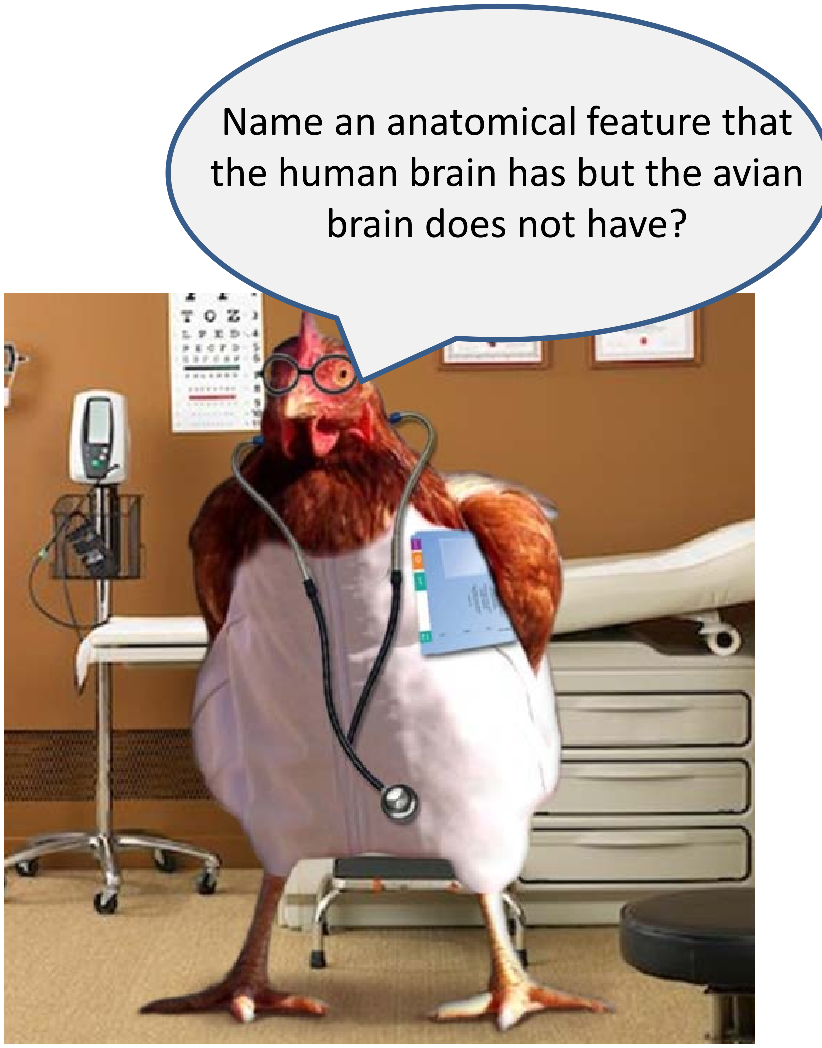
As part of an undergraduate senior project the prevalence of Group D Salmonella which include the foodborne pathogen *Salmonella* Enteritidis (SE) was tested in backyard poultry in Davis, California. Specifically, environmental swabs and blood samples were collected from 72 chickens in 15 backyard coops in order to assess the prevalence of SE in the coop environment and to measure the presence of antibodies against Group D *Salmonella* in the birds themselves. The drag swabs were submitted to the California Animal Health and Food Safety lab (CAHFS) for PCR isolation of SE, and the blood was mixed with a commercial *Salmonella* antigen to test for the presence of antibodies against Group D Salmonella in the chickens themselves. Positive results of the blood tests can be seen through “agglutination,” or binding of antigen to antibody meaning that the bird’s immune system previously encountered *Salmonella*. The drag swabs were tested in order to determine if live SE was present in the environment during the study.

In addition, to the laboratory results the coop owners were surveyed to gain insights concerning their knowledge of biosecurity, egg safety, and disease surveillance. The following are some highlighted results of the swab/blood sampling, and the findings from the survey:

- Two of the seventy-two birds tested positive for blood agglutination, but none (0/15) of the drag swabs from the 15 coops enrolled in the study were PCR positive for SE.
- 46.7% of participants observed wild birds flying into their coops. 26.7% stated that wild birds probably have access to the coop area.
- 53.3% of participants did not wash eggs, (note: egg washing is not recommended for BY poultry owners) but refrigerated them within 36 hours.
- 26.7% washed all collected eggs, and 20% said that eggs were not washed or refrigerated within 36 hours.
- 86.7% of the coop owners composted their bird’s manure.

- 6.7% of survey responders made coop visitors wear protective booties while 93.3% did not require coop visitors to wear any type of PPE.
- When informed about the free necropsy service that the CAHFS lab in Davis offers, 46.7% of the survey respondents (who were all Davis residents) were not aware that these services existed.

These results demonstrate the need for more robust extension and outreach to backyard poultry owners in the state of California.

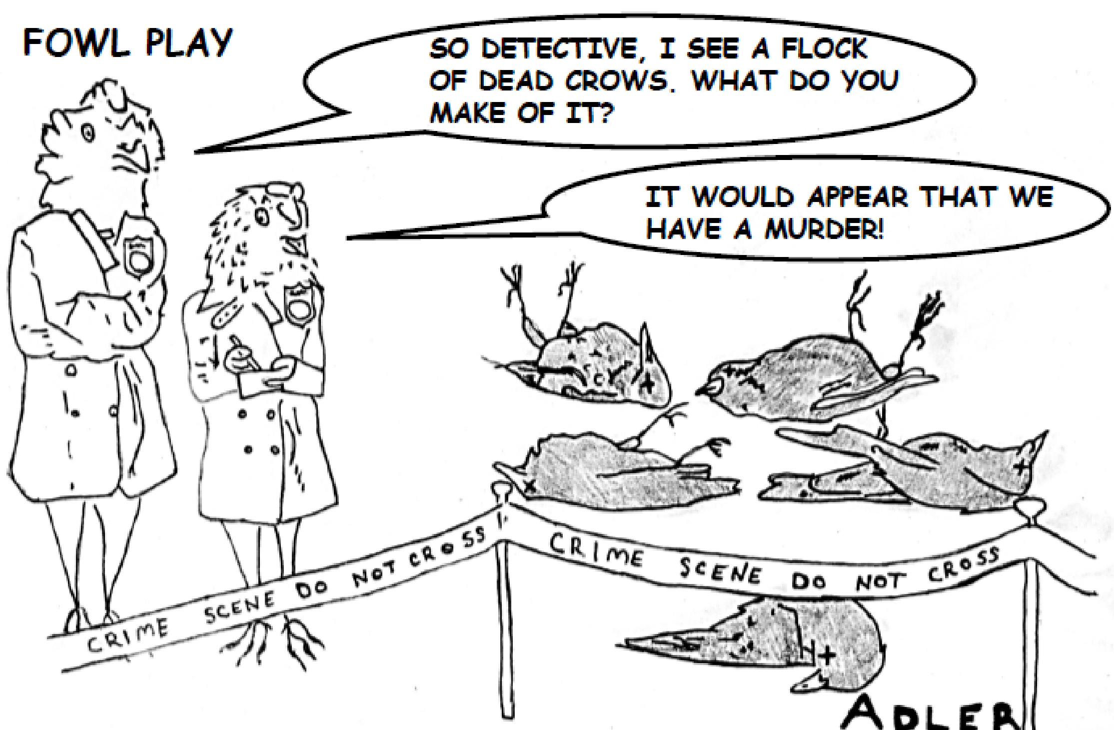


Last quarters trivia: The “flying ninja” (aka the Humingbird) can fly backwards. Dr. Cluck owes Dr Mark Bland a beer for submitting the correct answer.

Useful Information on Highly Pathogenic Avian Influenza information and prevention be found at: http://www.cdfa.ca.gov/ahfss/Animal_Health/Avian_Influenza.html

Meet the new poultry ethologist: Dr. Maja Makagon

My academic journey started at the University of Virginia, where I earned a bachelor's degree in biology. I spent a few years gaining field and bench research experience at the University of Hawaii, Manoa and UC Berkeley before pursuing graduate school at Cornell University (master's degree), and later at UC Davis (Ph.D.). My doctoral research was conducted in collaboration with a California duck producer, and ought to reduce the incidence of floor laying among breeder flocks. During my two years as apostdoc in the Animal Science Department at Michigan State University, I was part of a large, collaborative project that compared The sustainability of egg production across different types of laying hen housing systems. In 2012 I became an Assistant Professor in the Department of Animal Sciences at Purdue University. There, I developed a research program focused on the ways in which poultry perceive and interact with features of their environments, and the implications these interactions have on their management, productivity and well-being. *Continued on next page.*



"Fowl Play" is written by Dr. Evan Adler

Last year I was presented with the opportunity to relocate back to California, and am currently a member of the faculty in the Department of Animal Science at UC Davis. My research program continues to focus on the interplay between the behavior, management and well-being of poultry, including ducks, turkeys, laying hens and broilers. The projects conducted in my lab span 3 topic areas: 1) assessing the effects of the physical and social environments on bird behavior, 2) evaluating the relationship between behavior and bone integrity, and 3) developing and validating practical, species-specific welfare assessment measures. A common goal of this work is to develop strategies to help minimize behavior-related poultry management issues while optimizing bird welfare and production. I invite you to view my website (makagon.faculty.ucdavis.edu) in order to meet my graduate students and staff, and to learn more about our ongoing research. I am very excited to be back in California, and I look forward to developing strong collaborations with California's poultry industries.

Getting Ready to Hatch …

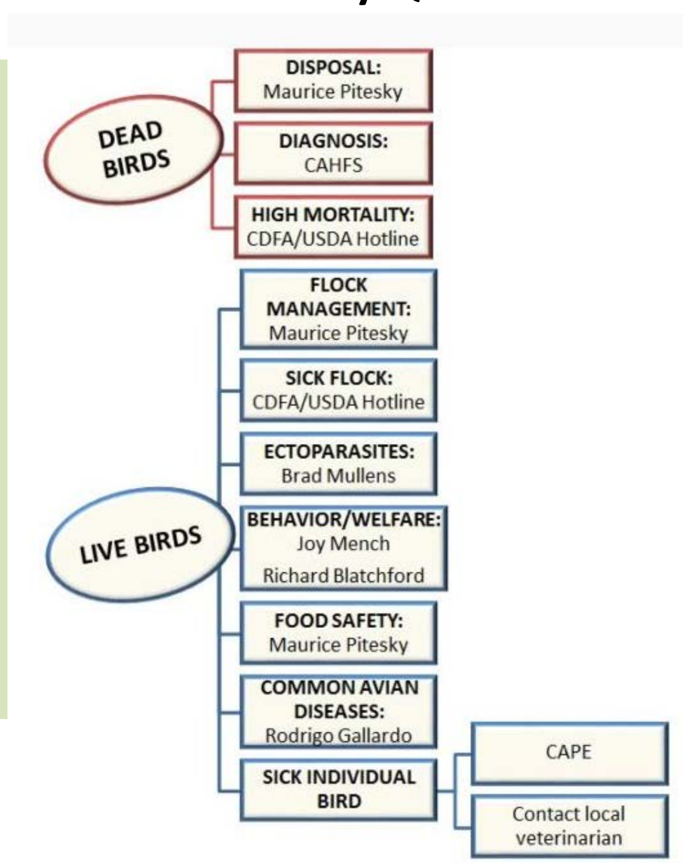
2016 California Egg Quality Assurance Program (CEQAP)

Northern California: 9/20
Stansislaus Country Ag Center

Southern California: 9/21
TBA

Conact Maurice Pitesky at mepitesky@ucdavis.edu for further information

Remember Who to Call if You Have Poultry Questions

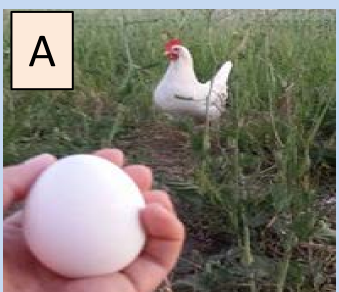


The web address for the this flow chart along with individual contact information is at:
http://ucanr.edu/sites/poultry/

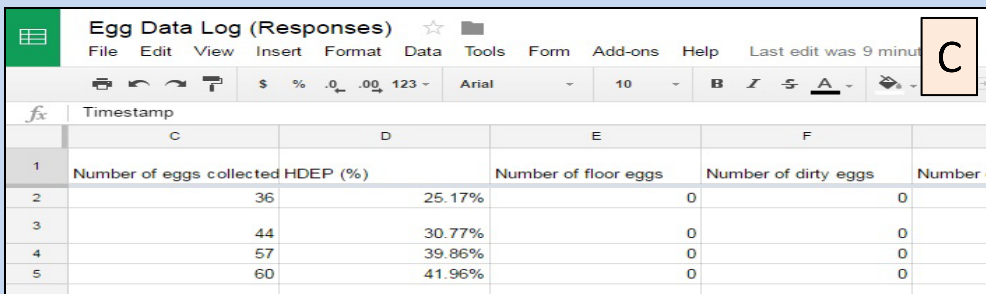
Easy, Free and Smart Data Capture Methods for Small Poultry Farmers

Myrna Cadena and Maurice Pitesky UC Davis , School of Veterinary Medicine-Cooperative Extension

Data collection and analysis are crucial components of animal production, but depending on your method of data capture and processing, they can be difficult and time-consuming tasks. Fortunately, free and easy to use tools such as Google Forms can help farmers record, share and analyze data more easily. At the UC Davis Pastured Poultry Farm, our team has created an “Egg Data Google Form” that captures basic production and egg quality data on a mobile device like your cell phone . **Once captured, the data is automatically stored on an spreadsheet and stored on the “cloud” meaning the data can be viewed instantly my multiple parties on a computer or mobile device. Therefore, there is no need to manually transfer data from a hand written data log!** For more information on how to setup/use Google Forms for data capturing, visit our website by “Googling” UC Davis Pasture Poultry” and then clicking on “innovations”



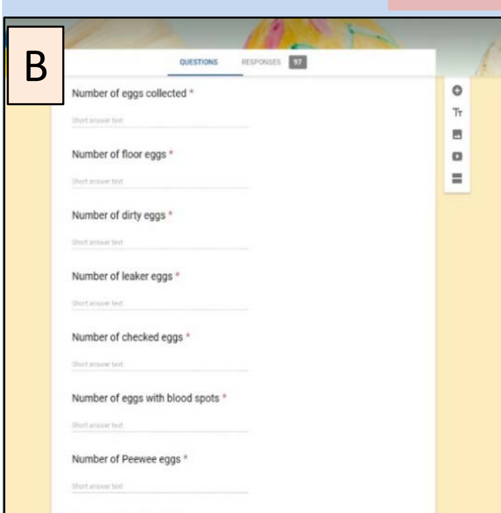
A. Eggs are collected



Egg Data Log (Responses)

	C	D	E	F	
1	Number of eggs collected	HDEP (%)	Number of floor eggs	Number of dirty eggs	Number o
2	36	25.17%	0	0	
3	44	30.77%	0	0	
4	57	39.86%	0	0	
5	60	41.96%	0	0	

C. Example of data that was automatically uploaded onto a Google Spread Sheet. This data can be viewed instantaneously once logged in at the farm or processing plant



B. Data is recorded at the farm or processing plant onto a mobile device using a google form

D Age in Weeks	UCD Hen-Day Egg Production (%)	Goal Hen-Day Egg Production (%)	UCD Hen-Housed Egg Production (%)	Goal Hen-Housed Egg Production (%)	UCD Egg No. per H.H.	Goal Egg No. per H.H.
22	34.4	60	33.1	60	1.3	7.7
23	74.6	75.1	71.6	75	6.3	12.9
24	92.0	85.2	88.3	85	12.5	18.8
25	92.7	90.3	89.0	90	18.7	25.1
26	92.3	92.4	88.6	92	24.1	31.5
27	92.2	93.5	88.5	93	30.3	38
28	90.2	94.1	86.2	93.5	36.3	44.5
29	92.8	94.6	88.4	93.9	42.5	51.1
30	94.1	95	89.3	94.2	48.7	57.7
31	93.4	95.3	88.4	94.4	54.9	64.3
32	92.1	95.5	87.1	94.5	60.1	70.9
33	97.1	95.7	91.9	94.6	66.6	77.5
34	94.7	95.9	89.6	94.7	72.8	84.1
35	91.8	96	86.3	94.7	78.9	90.7

D. From the spread sheet data can be easily analyzed. Below is a table comparing the performance of our flock with the published performance goals of the commercial breed used.