Feeding and lighting practices on small-scale extensive pastured poultry commercial farms in the united states

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ABSTRACT As commercial free-range and pastured poultry production has gained increased popularity in the United States in recent years, there is a greater need to understand basic husbandry practices including feeding and lighting practices. Because husbandry practices vary greatly between individual commercial pastured poultry and free-range operations, gaining knowledge across a wide cross-section of producers is necessary to better understand current practices. Specifically, because feed is considered the most expensive part of poultry production with respect to operating cost, in collaboration with the American Pastured Poultry Producers Association, an on-line survey of commercial free-range and pastured poultry producers was conducted aimed primarily at evaluating feeding and lighting practices. Data were collected from 14 commercial pastured (n = 13) and free-range (n = 1) producers (6 broiler, 1 layer, and 7 broiler/layer facilities) across 9 U.S. states. Results showed that these operations most commonly use Cornish Cross for broiler production and ISA Brown and Australorp for egg production. Only 1 of the 14 farms calculates feed conversion ratio on a monthly basis. Estimates of Hen Month Egg Production (**HMEP**) resulted in HMEP percentages that were over 100% in 6 of the 7 farms that provided data. 5 of the 7 farms that have layers used supplemental lighting but do not use a lux meter. These lack of data reflect an important challenge with this segment of the poultry industry. Extension based outreach focused on enabling data collection and record-keeping and analysis are necessary. Despite its small sample size, this study's results provide some valuable insights with respect to feeding equipment and the current state of data collection for this segment of the poultry industry.

Key words: pastured poultry, free-range poultry, feeding practices, lighting practices

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INTRODUCTION

Commercial free-range and pastured poultry production is a growing sector of the commercial poultry industry (Miao et al. 2005). Although in the U.S. there is no regulatory definition of "free-range" and "pastured poultry production", these systems commonly refer to a husbandry practice in which flocks of birds are raised indoors at night and have continuous outdoor access during the day with the primary difference being that pastured birds are raised on pasture as opposed to a dirt pad or other non-grass environment (Sossidou et al. 2011). While this may seem to be a minor difference, it is important to recognize that foraging occupies up to 25% of a chickens time (Miao et al. 2005). Therefore, if pasture is available, birds consume the associated grasses and seeds via choice feeding which thereby affects the total consumption of formulated feeding they are typically provided *ad libitum* (van de Weerd et al. 2009). While several factors including the nutritional quality of the forage, husbandry practices and the genetics of the birds affect pasture intake, studies have shown that pasture consumed by hens on a daily basis have a positive effect on health, welfare, and production (van de Weerd et al. 2009). For example, one study by Horsted et al., showed that hens consumed between 10–30 grams of grass/clover per day and after a period of adaptation were healthy and productive (van de Weerd et al. 2009; Horsted and Hermansen 2007). However, understanding the nutritional quality and consumption of pasture is significant because birds fed via choice feeding have been found to consume less protein than recommended which can affect productivity (Singh and Cowieson 2013; Fanatico et al. 2016).

Much of what we know about these alternative poultry husbandry practices has been acquired in commercial settings, which are not always reflective of contemporary pasture or free-range production operations (van Wagenberg et al. 2017).The significant lack of research on alternative production systems coupled with low connectivity to extension resources makes

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understanding the dynamics of this rapidly expanding market important. In this research note, we move away from the focus on production efficiencies (Folsch et al. 1988; Singh and Cowieson 2013) to examine husbandry practices focused on feed and lighting. It is important to recognize that pasture and free-range husbandry practices are highly variable and often hard to characterize in these types of alternative production systems. This variability makes characterizing differences in lighting, feed delivery, consumption, and conversion challenging, but critically important. To better understand this variability, we surveyed the range of feeding and lighting practices with the goal of developing a baseline level of knowledge for research and extension professionals.

MATERIALS AND METHODS

We conducted a short online questionnaire which was advertised via the American Pastured Poultry Producers Association (**APPPA**) Yahoo™ Group and our own network of alternative producers in California. APPPA is a nonprofit educational and networking organization dedicated to encouraging the production, processing, and marketing of pastured poultry; its list-serve had 607 members registered at the time of the survey. The questionnaire was composed of 45 ordinal and categorical closed or semi-closed multiple-choice questions. For the semi-closed questions, respondents were provided space for elaboration if they selected "other" as their response. The questionnaire was accessible from 2017 August to 2017 November. Per protocol the developed survey was submitted to the Institutional Review Board (**IRB**) office at UC Davis where it was determined that the survey was "exempt" from IRB approval.

RESULTS AND DISCUSSION

We used convenience sampling to increase participation. Convenience sampling is often the optimal way to gather information from an underserved population. Like many farm-based surveys, we had a low response rate (N = 14), but with surprisingly high geographic dispersion. Specifically, producers from 9 different states (including 13 commercial pastured poultry and one free-range) answered the survey (Table 1). The wide geographic dispersion offers some insights and trends as to feeding and lighting practices among the states surveyed. Nonetheless, generalizing from non-representative sampling to a larger population is not considered scientifically valid for convenience sampling. Consequently, the results of this survey should be considered exploratory. However, from an extension perspective, these type of surveys provide valuable insights regarding a generally under-surveyed segment of the commercial poultry industry To the best of our knowledge, this survey represents the first of its kind for this posegment of the commercial poultry industry in the U.S.

The free-range and pastured poultry producers responding to the survey came from California (4/14), followed by Pennsylvania (2/14) and Arkansas, Florida, Hawaii, Kansas, Michigan, Minnesota and finally, Missouri with one response (Table 1). The average and median number of layers (at the time of the survey) and broilers (annual production) were 151 and 100 (range: 14–350) with respect to layers and 27,723, and 1450 (range: 7–150,000) with respect to broilers (Table 1). Interestingly, half (7/14) of the producers identified their farms as both broiler and layer facilities (Table 1). These farms used primarily ISA Browns (4/7) for eggs and Cornish Cross (5/7) for meat production (Table 1).

As noted in the introduction, our primary objective was to develop wider knowledge about feeding and lighting practices on commercial free-range and pastured farms. Feeding practices, in particular, are important to understand due to the economics of feed costs. Specifically, in conventional production systems, feed costs are estimated to account for up to 70% of the operating cost of a flock (Bell and Weaver 1990). The question of how much feed is potentially displaced by free-ranging flocks who spend as much as 25% of their time foraging is poorly understood (Miao et al. 2005) in part because answering questions related to feed

Table 1. Selected field survey data of commercial pastured and free-range farms.

Farm	Location (State)	Husbandry	Broiler/layer	# of Layers (current)	# of Broilers (annual)	Breeds
A	Arkansas	Pasture	Both	350	12,000	ISA Brown Cornish Cross Australorp
B	California	Pasture	Both	70	–	Delaware
C	California	Free-Range	Broiler	–	900–2000	–
D	California	Pasture	Broiler	–	130,000	Cornish Cross
E	California	Pasture	Broiler	–	150,000	Cornish Cross Freedom Ranger
F	Florida	Pasture	Broiler	–	600	Freedom Ranger
G	Hawaii	Pasture	Layer	100		ISA Brown Plymouth Rock Ameraucana
H	Kansas	Pasture	Broiler	–	400	Cornish Cross
I	Michigan	Pasture	Both	–		ISA Brown Cornish Cross
J	Minnesota	Pasture	Both	14	300	Rhode Island Red, Cornish Cross, Black Australop
K	Missouri	Pasture	Both	25	7	Australorp
L	Not identified	Pasture	Both	200	6000	ISA Brown Cornish Cross
M	Pennsylvania	Pasture	Broiler	–	200	Cobb Sasso
N	Pennsylvania	Pasture	Both	300	4000	ISA Brown Cornish Cross

Table 2. Selected field survey data related to feed utilization.

Farm	Feed Intake/ mo	Type of feed used (Mash, Crumble, Pellet)	Access to feed	Do you calculate FCR?	Most recent FCR	How often do you calculate	Egg production/ mo	HMEP[B]	Feeder type	Estimate of feed waste
A	8618 kg	M	Ad libitum (broilers) 0.25 lbs/day (layers)	Y	2.5	Spot check	440	125.7%	C	< 5%
B	408 kg	P	Ad libitum	N	–	–	120	58.3%	D	< 5%
C	644 kg	P & Fermented[A]	Ad libitum (day only)	Sometimes	–	Monthly	–	–	E	< 5%
D	54,431 kg	C & P	Ad libitum	Y	4.3	Annually	–	–	C	5–10%
E	n/a	C & M	Ad libitum	Y	2.2	Annually	–	–	D	5–10%
F	550 kg	C	Ad libitum	N	–	–	–	–	D, F	5–10%
G	472 kg	Whole & Cracked Grain	Measured amount (day), fermented grains in evening	N	–	–	152	152.0%	E, G, H	5–10%
H	n/a	Grain with supplements	Free access (day only)	N	–	–	–	–	C	–
I	5500 kg	C	Ad libitum	N	–	–	1280	–	F	< 5%
J	272 kg	C	Ad libitum	N	–	–	312	2228.6%	E	5–10%
K	109 kg	C	Measured amount	N	–	–	28	112%	D	10–15%
L	4990 kg	Ground/Milled	Ad libitum (broilers) Measured amount (layer)	N	–	–	320	160.0%	D	< 5%
M	n/a	M	Ad libitum	Y	4.5	Per flock	–	–	–	< 5%
N	8000 kg	C	Ad libitum	Y	3.25	Annually	4400	1466.6%	E	< 5%

[A]Homemade diet with greens and fish.
[B]Hen-Month Egg Production % (# of eggs/# of layers).
[C]Plastic, multi-access, portable, gravity-fed, shade lid.
[D]Plastic, multi-access, portable, gravity-fed.
[E]Metal, multi-access, portable, trough.
[F]Metal, multi-access, portable, gravity-fed, shade lid.
[G]PVC pipe, single access, wall-mounted, pipe trough.
[H]Feed spread out on ground by hand.

consumption require robust data gathering. In our survey only one of the respondents calculated a weekly feed conversion rate (**FCR**) (Table 2). Most (8/14) did not even calculate a FCR (Table 2). Ideally, FCR should be calculated weekly (i.e., g/bird/day). Among the farms that reported an FCR (N = 5), the range was between 2.5 and 4.5 kg feed/kg eggs or meat which are higher than their breeds performance standards. The reported FCRs are above the overall published FCRs found in the literature and in management guides for conventional farming (McCrea et al. 2014). The high FCRs in our survey could be partially related to feed wastage which was estimated by respondents to be between less than 5 and 10–15% of total feed (Table 2). Other trends related to FCR including feeder type and type of feed were not observed (Table 2). In addition, these differences in FCR between management guides and the farms should be viewed in the context of the respective husbandry practices used and the greater variability of husbandry practices within free-range and pastured poultry production. For example, we know that temperature variation and the availability of additional movement space can negatively affect production (Miao et al. 2005), which, in turn, affects FCR. Consequently, we expect that the FCRs collected for alternative production will serve largely as a benchmark for an individual farm, rather than as a comparison between farms or to a breed management guide.

We also calculated the Hen-Month Egg Production % (**HMEP**). While similar data is often collected daily or weekly by conventional operations and presented as a % Hen-Day calculation, this information is not regularly collected for the smaller alternative production systems (Table 2). Interestingly, 6/7 layer farms produced HMEP values above 100% (Table 2). This reflects some type of misreporting by the survey respondents. More importantly, the result indicates a lack of robust data gathering and record-keeping practices which are essential to develop a better understanding of economic viability for the producer.

Lighting supplementation is typically a challenge in pastured poultry primarily because of lack of electricity. However, reduced costs and commercial availability of generators, batteries, and solar panels have made lighting a viable option in remote locations without electricity. In our survey with respect to supplemental lighting, we were somewhat surprised to find that only 3 of the 8 farms reported providing supplemental light (Table 3). Two additional farms in California and Michigan reported that they provide supplemental light only in the winter (Table 3). None of the 5 farms that provide supplemental light reported using a luxmeter. Not providing supplemental light in layers as the day length decreases can affect productivity and can cease egg production completely (Miao et al. 2005).

Continued efforts are necessary to better characterize feeding and lighting practices in alternative production systems. We know very little about the range of practices currently utilized by alternative commercial poultry producers. Producers recognize the importance of

Table 3. Selected field survey data related to light utilization.

Farm	Use of supplemental lighting	Total light hours (sunlight + supplemental)	Use of Luxmeter
A	Y	16	N
B	Winter only	12	N
C	N	–	–
D	N	–	–
E	N	–	–
F	N	–	–
G	N	–	–
H	N	–	–
I	Winter only	16	N
J	Y	8	N
K	Y	16	N
L	N	–	–
M	N	–	–
N	N	–	–

these challenges. In a previous survey by our group, alternative poultry producers were asked to identify their most important challenges. Two-thirds of those responding (64%) reported that providing adequate feed at a reasonable cost was the most important challenge (Dailey et al. 2017). In that same survey, improving egg production rates and/or feed conversion ratio were the most frequently cited with respect to the need for additional outreach material (Dailey et al. 2017). In order to address this, we have instituted a series of 7 annual workshops in California and Oregon as part of a 3-yr Beginning Farmer Rancher and Development Program USDA grant. This type of training in addition to training associated with utilizing cloud based forms for data collection and analysis are essential with respect to benchmarking productivity and profitability in commercial pastured operations.

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REFERENCES

Bell, D., and W. Weaver 1990. Commercial Chicken Meat and Egg Production. Volume 5th edn. New York (NY): Kluwer Academic Publishers.

Dailey, N., D. Niemeier, C. Elkhoraibi, C. G. Sentíes-Cué, and M. E. Pitesky. 2017. Descriptive survey and surveillance of salmonella on pastured poultry layer farms in California. Poult. Sci. 96:957–965.

Fanatico, A. C., C. M. Owens-Hanning, V. B. Gunsaulis, and A. M. Donoghue 2016. Choice feeding of protein concentrate and grain to organic meat chickens. J. Appl. Poult. Res. 25:156–164.

Folsch, D. W., H. U. Huber, U. Bolter, and L. Gozzoli. 1988. Research on alternatives to the battery system for laying hens. Appl. Ani. Behav. Sci. 20:29–45.

Horsted, K., and J. E. Hermansen. 2007. Whole wheat versus mixed layer diet as supplementary feed to layers foraging a sequence of different forage crops. ANM 1:575–585.

McCrea, B. A., A. F. Mills, K. Mathews, and J. Hutson. 2014. Performance and carcass characteristics of delaware chickens in comparison with broilers. J. Appl. Poult. Res. 23:586–592.

Miao, Z. H., P. C. Glatz, and Y. J. Ru. 2005. Free-range poultry production - A review. Asian Australas. J. Anim. Sci 18:113–132.

Singh, M., and A. J. Cowieson. 2013. Range use and pasture consumption in free-range poultry production. Anim. Prod. Sci. 53:1202–1208.

Sossidou, E. N., A. D. Bosco, H. A. Elson, and C. M. G. A. Fontes. 2011. Pasture-based systems for poultry production: Implications and perspectives. Worlds Poult. Sci. J. 67:47–58.

Van Wagenberg, C. P. A., Y. de Haas, H. Hogeveen, and M. M. van Krimpen. 2017. Animal board invited review: Comparing conventional and organic livestock production systems on different aspects of sustainability. Animal 11:1839–1851.

Van De Weerd, H. A., R. Keatinge, and S. Roderick. 2009. A review of key health-related welfare issues in organic poultry production. Worlds Poult. Sci. J. 65:649–684.