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Use of the Outdoor Range and Activities of Rhode Island Red Hens Grazing on Natural Vegetation in the Tropics

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ABSTRACT

The aim of this study was to investigate the range utilization of Rhode Island Red hens, grazing outdoor (under tropical conditions) and to scan their activities inside the house as well as during their outdoor visits. The activities of RIR hens, raised in indoor floor pens connected with outdoor areas covered with natural vegetation, were scanned and recorded individually within 15 minute intervals between 08:00 and 17:00 hours (37 scans a day) for a duration of twelve weeks. The results revealed that, 40.5% of the hens were observed to be on the range at each scanning time; where they engaged their outdoor visits in foraging (11.4%), exploring (8.62%), roaming (6.1%), standing (3.5%), primping (5.6%) and resting (5.4%). Besides, the utilization of the closest part of the range to the house was significantly the highest in comparison with the middle and farthest parts (73.0 *vs.* 24.9 and 2.1%, respectively), and the highest (P< 0.05) average utilization of the range was recorded during the early day hours, versus the midday and late day hours. In total, 24 meters apart from the house forms the most adequate distance for free range RIR hens while longer distances would rarely be visited. The grazing RIR hens (in the tropics) utilized the outdoor area effectively and performed natural behavior.

Keywords: Behavior, Free range, Range utilization, Rhode Island Red, Tropical forage.

INTRODUCTION

Free range production systems allow animals, including poultry, to behave their natural behavior and be provided with sun-light, fresh air and access to ample space, offering them better health and a lower stress environment (Fanatico, 2006; Ponte *et al*., 2008; Mench *et al*., 2011). In addition, free range systems could contribute to production sustainability and likely reduce the feed cost through obtaining various feed items from the range area, such as grass, insects and earthworms (Reddy and Qudratullah, 2004; Steenfeldt *et al*., 2001; Ponte *et al*., 2008; Abouelezz *et al*., 2012).

Unluckily, several previous studies on many flocks of commercial production indicated low percentage of broilers and hens using the range area, which reduces the anticipated benefits of the outdoor systems (Hegelund *et al*., 2005; Harlander-Matauschek *et al*., 2006; Hegelund *et al*., 2006). Several parameters have been reported to reduce the acceptance of the range area by hens; such as extreme weather conditions, age, strain and poor management (Keeling *et al*., 1988; Hegelund *et al*., 2005). Besides, there are recommendations for free range hen densities, while there are no specific recommendations regarding the adequate distance of range for laying hens (Fanatico, 2006). In addition, there is scant information on how and where the hens spend the time of their outdoor visits, *i.e.*, in which activities and to which distance they can leave the house. Studies on the range

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utilization and behavior of free range hens under different managerial conditions and various climatic zones, particularly in the tropics, are still remain to be carried out, which would help in avoiding production seasonality and to investigate the range acceptability and adoption by hens (Lay *et al*., 2011; Mench *et al*., 2011; Abouelezz *et al*., 2012). Therefore, the current study was designed to evaluate the range utilization, behavior and activities of Rhode Island Red hens grazing on natural vegetation in the tropics.

MATERIALS AND METHODS

This experiment lasted twelve weeks, preceded by two weeks of adaptation period. The experimental work was carried out between March and June 2011, using the poultry facility of Faculty of Veterinary Medicine and Animal Science (FMVZ), University of Yucatan (UADY), Yucatán, Mexico. The climate here is sub-humid with an average annual rainfall (highly variable) of 960 mm between June and October accompanied by 6-7 months of dry period.

The average temperature figures were obtained from the Meteorological station of Yucatan; which revealed the average temperature recordings estimated at 31.4±2.4˚C during the range time (8:00 to 17:00 hours) throughout the experiment. Besides, the temperature (throughout the experiment) averaged 28.5, 33.6, and 31.2˚C during the daytime test periods of: 8:00 to 11:00; 11:00 to 14:00 and 14:00 to 17:00 hours, respectively.

Bird management and Experimental Design

Forty- eight Rhode Island Red hens (27 week-old), reared in indoor floor pens in a semi closed house from hatch up to the experiment initiation, were housed in an opened house and allocated to twelve floor pens (each pen of 3 m^2 accommodating four hens) which in turn were divided randomly into two groups, each group replicated six times. The replicates of the first group were raised indoors only, while each of the second group replicates was connected to an outdoor area with natural grown vegetation (120 m^2) using a Pop-hole (35×30 cm), left opened from 8:00 to 17:00 hours daily**.** Both groups were fed *ad libitum* on a commercial layer diet (16.5% crude protein and 2.85 Mcal ME kg^{-1} diet). Wood chips were used as litter material and an egg nest, a circular feeder as well as a drinking set-up were installed in all the pens inside the house.

Preparation of the Range Area

The range area (720 m^2) was divided into six longitudinal subplots (each of 120 m^2) having the dimensions of 3.53×34 m. The range divisions benefited from similar shadows from a group of tall trees previously structured in the run. The plants were identified and the repetition of each plant and the vegetation density in the range subplots were recorded according to the methods of Caamal (2004). By the beginning of the experiment, all outdoor subplots were made homogenous, having the same similar types of plants as well as vegetation density. The plant heights ranged between 20 and 50 cm and the vegetation cover in all the range subplots extended to 22.5, 56.4 and 86.9% within the closest, middle *vs.* farthest parts from the house, respectively. The predominant range plant species are presented in Table 1.

Behavior Study

The activities of the experimental birds were studied for the individual birds in either of the indoor and outdoor groups. The monitored activities inside the house for both groups included: laying, eating, drinking, roaming, exploring, standing, resting and primping. In addition, the outdoor activities included: foraging,

Table 1. Frequency percentages (%) and scientific names of plants observed in the range area.

Scientific name	Plant frequency (%)
Leucaena leucocephala	22.58
Cenchrus ciliaris	18.97
Achyranthes aspera	13.40
Neomilspaughia emarginata	10.52
Neurolaena sp.	7.53
Amaranthus hybridus	5.46
Morinda yucatanensis	4.95
Sida acuta	4.12
Gymnopodium floribundum	2.27
Bidens sp.	2.16
Malva sp.	1.65
Pennisetum purpureum	1.34
Ruellia nudiflora	1.13
Elythraris imbricate	1.13
Azaridachta indica	0.62
Momordica charantia	0.52
Mucuna deeringiana	0.41
Capsicum annuum	0.31
Merrenia sp.	0.21
Portulaca oleraceae	0.21
Borreria sp.	0.21
Euphorbia sp.	0.21
Parthenium hysterophorus	0.10
Total	100.00 (%)

exploring, resting, primping and roaming. The range subplots were divided into three parts marked with white sticks on the fence at 12, 24 and 34 m from the house, for recording the location site of the hens in the range area. These parts were categorized as being: close to the house (0 to 12 m), middle part (12 to 24 m) and farthest away (24 to 34 m) from the house. The activities of hens in either group were scanned and recorded in 15 minutes intervals after opening the pop holes at 8 am up to 5 pm (37 scans a day). The same routine was repeated weekly throughout the twelve weeks of the experimental period. The behavioral activities were studied and evaluated according to the methodology of Mirabito and Lubac (1998), Zeltner and Hirt (2003), and Hegelund *et al*. (2005).

Statistical Analyses

The experimental design corresponded to a split split-plot design, where the main plot represented the system (outdoor, indoor), the subplot denoted the week (12 weeks) and the sub-sub-plots the time of the day (8:11; 11:14, and 14:17 hours). The statistical model which described the outdoor-indoor activities (laying, eating, drinking, roaming, exploring, standing, resting and primping) included the fixed effects of the system, error *a* (the interaction system×pen), week, error *b* (the interaction system×week) and time of the day, as well as the residual (error c). Mean comparisons were carried out using Tukey test at 5% error type 1 level.

RESULTS

The range activity averages of the outdoor *vs.* indoor groups are presented in Tables 2 and 3, respectively. Regarding the activities of the outdoor group, the average percentage of time spent outside the house estimated 40.5%, consisting of 11.4% foraging, 8.6% exploring, 6.2% roaming, 3.5% standing, 5.4% resting and 5.6% primping. The activities inside the house of same outdoor group consisted of laying (7.2%), eating (12.0%), drinking (6.4%), exploring (6.2%), resting (7.2%), roaming (6.0%), standing (11.6%) and primping (3.1%), which accounted for 59.5% of the time between 8 and 17 hours. On the other hand, the indoor hens had spent the period from 8:00 to 17:00 hours in laying (5.9%), eating (19.3), drinking (7.3%), exploring (13.4%), resting (16.0%), roaming (15.6%), standing (14.4%) and primping (8.1%).

Regarding the activities during the periods of the day 8:00 to 11:00; 11:00 to 14:00 and 14:00 to 17:00 hours, indicated that majority of hens in both treatments had laid in the early period (8 to 11 hours) versus the midday and late periods which amounted to 11.2 versus 7.3 and 3.1% for the outdoor group and 8.3 versus 6.9 and 2.6% in the indoor group, respectively. The percentage

Table 2. Means of range activities and behavior of the outdoor Rhode Island Red hens during the daytime periods (8 to11 hours), (11 to 14 hours) and (14 to 17 hours).[a]

Activities	Daytime periods			SEM
	8 to11 hours	11 to 14 hours	14 to17 hours	
Activities inside the house *(%)*				
Laying	11.2[a]	7.3[b]	3.1[c]	0.9
Eating	10.2[a]	14.3[b]	11.4[ab]	1.1
Drinking	3.4[a]	7.9[b]	7.9[b]	0.8
Exploring	4.2[a]	5.7[ab]	8.3[b]	1.0
Resting	3.7[a]	8.0[b]	9.8[b]	1.0
Roaming	7.8[a]	5.0[b]	5.1[b]	1.1
Standing	11.3	10.9	12.6	0.9
Primping	2.1[a]	4.7[b]	2.5[a]	0.6
Total	53.9	63.8	60.7	
Activities in the outdoor run *(%)*				
Foraging	14.2[a]	7.9[b]	12.1[a]	1.3
Exploring	10.8[a]	6.4[b]	8.7[ab]	1.0
Roaming	8.2[a]	5.0[b]	5.0[b]	0.8
Standing	3.5	3.7	3.2	0.7
Resting	2.7[a]	7.8[b]	5.6[b]	0.9
Primping	6.7	5.4	4.7	0.9
Total	46.1	36.2	39.3	

[a] Means with different superscripts within the same row are significantly different (P< 0.05).

Table 3. Means and SEM of activities and behavior of the indoor raised Rhode Island Red hens.[a]

Activities (%)	Daytime periods			SEM
	8 to11 hours	11 to 14 hours	14 to17 hours	
Laying	8.3[a]	6.9[a]	2.6[c]	1.1
Eating	19.3[ab]	22.6[b]	16.0[a]	2.0
Drinking	3.8[a]	8.1[b]	10.0[b]	1.0
Exploring	16.3	11.9	12.0	1.2
Resting	5.9[a]	16.8[b]	25.2[c]	1.5
Roaming	24.9[a]	12.5[b]	9.5[b]	1.7
Standing	14.3	13.4	15.4	1.5
Primping	7.2	7.8	9.3	1.2
Total	100.0	100.0	100.0	

[a] Means with different superscripts within the same row are significantly different (P< 0.05).

of resting as well as drinking was almost doubled at both the middle and late periods versus the early one (P< 0.05).

The least percentage of hens which were found to be using the outdoor area (36.2%) was recorded during the midday period (11 to 14 hours), of which a majority (78.1%) was found in the closest part of the house, higher (P< 0.05) than the same percentage recorded in the early and late periods (Table 4). In addition, the overall time spent in the nearest (0-12 m), middle (12-24 m) and farthest (24-34 m) parts of the outdoor area represented 73.0%, 24.9% and 2.1% of the total time between 8 to 17 hours.

The range utilization averages showed no significant results of inconsistent trend during the experimental weeks (Figure 1). Besides, no significant differences (P< 0.01) were detected between the experimental periods, on range utilization, estimated 37.97% and 43.04% during the periods of: 1 to 6 versus 7 to 12 weeks, respectively.

Table 4. Effects of daytime periods on utilization (%) of range parts by RIR hens.[a]

	Daytime periods			SEM	Overall
	8 to11 hours	11 to 14 hours	14 to17 hours		8 to 17 hours
Percentage of hens observed outdoors (%)	46.1[a]	36.2[b]	39.3[b]	2.7	40.5
Utilization of range parts (%)					
Part 1 (0–12 m)	63.1[a]	78.1[b]	66.3[a]	3.1	73.0
Part 2 (12–24 m)	31.7[a]	20.2[b]	29.9[a]	2.9	24.9
Part 3 (24–34 m)	5.2[a]	1.7[b]	3.8[a]	1.1	2.1

[a] Means with different superscripts within the same row are significantly different (P< 0.05).

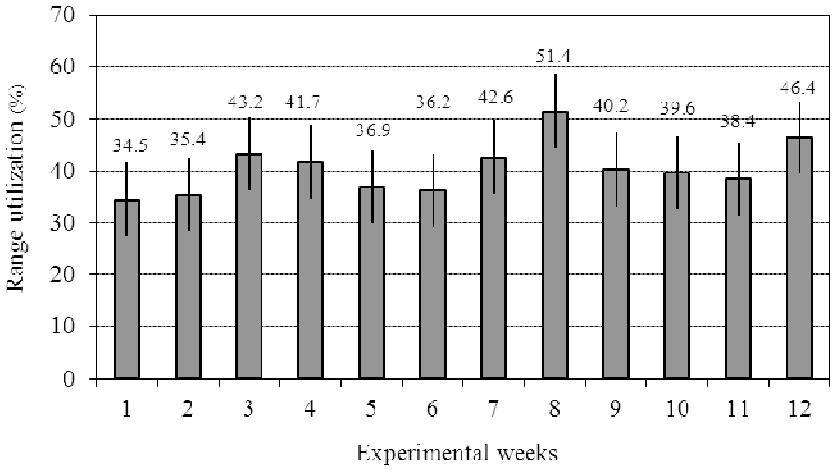

Figure 1. Range utilization percentages (%) during the experimental weeks (No significant differences found)

DISCUSSION

The range utilization percentage of laying hens is considered of great importance; where a good utilization of the outdoor area optimizes the anticipated benefits of the free range systems (Harlander-Matauschek *et al*., 2006). In the current study, the hens had utilized the outdoor area effectively in practicing their natural behavior, where they were found to be foraging, exploring, roaming, scratching, wing flapping, dust-bathing as well as resting. The obtained range utilization percentage (40.5%) in the current study is considered higher than the corresponding values obtained in previous studies, where the reported utilization values of the range amounted to 12% (Bubier and Bradshaw, 1998), 11 to 23% (Mirabito and Lubac, 2001), 9% (Hegelund *et al*., 2005) and 18% with a range of between 7 and 38% (Hegelund *et al*., 2006).

Among the reported factors affecting the usage of the outdoor run, the weather conditions, the availability of shade and shelters, the availability of good quality vegetation, protection from falling prey, feeding system, housing design, management and flock size are considered as the most important (Hughes and Dun, 1984; Mahboub *et al*., 2002; Mahboub *et al*., 2004; Thiele and Pottgüter, 2008). The controversy of the present results with those of the previous research could be attributed to the fact that hens were provided with

good vegetation through use of a combination of different types of plants. Interestingly, the followed methodology in the current study goes in harmony with the recommendations of Bubier and Bradshaw (1998), in which they declared the importance of using the *ad libitum* feeding, which would prevent the hens from staying in or near the house in anticipation of specific feeding time as happens in the case of restricting the bird's feeding lot. In addition, they suggested using a combination of vegetation including shrubs or trees which attract more hens to visit the outdoor area and therefore to increase the range usage. The results by Harlander-Matauschek *et al.* (2006) indicated similar conclusions, where the range utilization percentage increased from 31% for the hens with almost no-vegetation covering, to 38% for the hens using an area with vegetation.

Protecting the birds from the burning sun through provision them with an adequate source of shadow seems to be a major factor for increasing the range utilization, particularly under the tropical climate. Besides, the results indicated that the pattern and percentage of range utilization was clearly affected by the daytime periods. Evidently, the highest utilization average was obtained during the early hours (8:00 to 11:00 hours), versus the midday and late hours 11:00 to 14:00 hours and 14:00 to 17:00 hours (46.1 *versus* 36.2 and 39.3%). In addition, the increased temperatures during the midday period could be associated with restricting the movements of a majority of the hens which used the range in the closest vicinity. Undoubtedly, the highest utilization percentage of the first part was recorded in the midday period which also recorded the lowest utilization values of the farther parts of the range versus the early and late periods (Table 4). Moreover, the lowest ($P< 0.05$) foraging rate was recorded in the midday period versus the early and late periods (7.9 *versus* 14.2 and 12.1%).

Hegelund *et al*. (2005) showed that the number of hens on the range increased until temperature reached about 17˚C, after which the number decreased where they preferred to stay inside to utilize the house's shadow. In addition, the increased temperature could be associated with the increased percentages of drinking and resting by both groups (Tables 2 and 3) during the midday and the late periods. In total, the effect of increased temperatures along with strong sunshine, particularly at the midday on affecting the pattern of range utilization seemed to be occuring. However, the obtained range utilization values are still high when compared with the results obtained in previous investigations, which could indicate that the incidence of the high trees in our study area has provided the hens with sufficient shadows.

Knowing how far a distance would be visited regularly by hens is considered as very important. In the current study, a high number of hens were observed to be gathered in the closest part of the range, representing 73.0% of the total hens observed outdoor, at each scanning time *versus* 24.9 and 2.1% in the middle and other farthest parts, respectively. This low utilization average observed in the farthest parts of the range suggests that 24 meter length could be the most adequate distance for free range RIR hens with further distances being rarely visited. Similar results have been obtained by Zeltner and Hirt (2003), who reported that the hens which had used the range area represented 22%, and the percent of hens that stayed in closer quarter to the poultry house (69.5%) was higher than the percent found in the farther quarters, the second (15.7%), third (8.7%) and fourth (6.8%).

Also, the findings of Hegelund *et al*. (2005) indicated that a majority of the hens stayed in the closest and middle parts with respect to the distance of the house, while almost no hens were seen in the farthest sections. In another study using Danish commercial organic egg-producing flocks, Hegelund *et al*. (2006) showed that in most cases a sum of over 40% of the hens stayed very close to the hen house, while in some flocks the farmers succeeded in attracting

the hens away from the direct vicinity of the hen house (less than 40% of the hens apearing in the zone 0 –5 m); but even then less than 20% of the hens were further away than 35 m from the house. With free range broilers, Rivera-Ferre *et al*. (2007) suggested that 20–17 meters could be a critical distance, which was seldom surpassed by broilers even when provided by extra shelters.

The obtained range utilization results in the current study showed inconsistent trends without significant differences (ranging between 34.5 and 51.37%) throughout the 12 weeks of experimental period (Figure 1). Similarly, the temperature ranged between 29.4 and 33.0˚C throughout the experimental weeks following an inconsistent pattern. In addition, the range utilization by RIR hens was not affected by the experiment period; where no significant difference (on range utilization percentage) was detected between the two halves of the experimental periods. In contrast, the results reported by Mirabito and Lubac (2001) suggest that the range utilization by laying hens could be increased by the increased range familiarity, where they showed that the mean distance visited by hens increased from 20 to 36 m between the period of 7 and 11 weeks, showing greater values within the nearest 10 meters from the house than expected.

Regarding the overall activities of the indoor *vs.* outdoor groups, the laying activity represented 7.2% of the total assessed activities in the outdoor group versus 5.9% of the indoor group, which could be attributed to the increased egg production in the outdoor versus indoor group described previously by Abouelezz *et al*. (2013). The indoor group spent around 19.3% of the time in feeding versus 23.4% for the outdoor group, as total of eating (12%) plus foraging (11.4%). In addition, the outdoor group spent 5.6% of their time in primping in the free range area, which included feather cleaning, wing flapping, sun and dust bathing; in addition to 3.1% as primping time inside the pens, which amounted to 8.7% in total for the outdoor group *versus* 8.1% for the indoor group. Due to the availability of such various activity options for the outdoor group; as foraging, dust-bathing and primping, the indoor group engaged more time in waking and exploring (29 *versus* 26.8%) than the outdoor group which was engaged more in laying, feeding, foraging and primping (Tables 2 and 3).

The Rhode Island Red hens grazing at natural vegetation under the tropical climate utilized the outdoor area effectively and performed their natural behavior. The highest utilization rate of the range was obtained during the early hours versus the midday and late periods which recorded the highest utilization of the closer part to the house and the lowest foraging rate. Besides, 24 meters of the range from the house seems an adequate range distance for grazing RIR hens.

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استفاده از چراگاه محیط آزاد و نظارت بر فعالیتهای مرغ‌های نژاد Rhode Island Red به هنگام چرای سبزه و گیاه طبیعی

ف. م. ک.ابوالعز، ل. سارمی نتو- فرانکو، ر. سانتوز- ریکالد، و ج. سگورا – کوری یا

چکیده

هدف از مطالعهٔ حاضر عبارت بود از برآوردی از استفادهٔ مرغان نژاد Rhode Island Red از چرای در محیط غیر سربسته (تحت شرایط منطقه حاره) و پی‌گیری فعالیت مرغ‌ها در درون سالن و همچنین بهنگام سرزدن آنها به محیط خارج از محیط سرپوشیده . فعالیتهای تک تک مرغهای RID در حین پرورش در محیط سرپوشیده‌ای که وصل به محیط بیرون (محیط تحت پوشش سبزه و گیاه طبیعی) بود در فواصل زمانی ۱۵ دقیقه‌ای بین ساعات ۰۰: ۸ و ۰۰: ۱۷ (روزانه ۱۷ نوبت) به مدت ۱۲ هفته اسکن و ضبط گردید. نتایج نشان داد که ٪ ۴۰/۵ مرغان در هریک از نوبت‌های اسکن شدن در چراگاه، جائی که در آنجا وقتشان به ترتیب صرف تغذیه از علوفه (٪ ۱۱/۴)، کنجکاوی (٪ ۸/۶۲)، پرسه‌زدن (٪ ۶/۱)، ایستادن (٪ ۳/۵)، آرایش و به خود رفتن (٪ ۵/۶) و استراحت کردن (٪ ۵/۴) می‌شد حاضر بودند. علاوه بر این، مشخص شد که استفاده از نزدیکترین بخش متصل به محیط سرپوشیده با بقیه بخشها یعنی بخشهای با فاصلهٔ متوسط و دور (٪ ۷۳/۰ در قیاس با ٪ ۲۴/۹ و ٪ ۲/۱) دارای تفاوت معنی‌داری بود. بالاترین ($P< ۰/۰۵$) معدل ساعات استفاده از چراگاه در ساعات اولیه روز (در قیاس با ساعات میانی و آخر روز) بود. به طور کلی، فاصلهٔ ۲۴ متری از محیط سرپوشیده سالن‌ها مناسبترین فاصله برای چرای مرغهای RIR تشخیص داده شد و فاصله‌های طولانی‌تر به ندرت مورد استفاده مرغها واقع شدند. مرغهای چرندهٔ RIR در محیط آزاد (در منطقهٔ حاره) به نحوه مؤثری از محیط استفاده برده و دارای رفتاری طبیعی بودند.