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Appraisal of cognitive abilities by virtue of training in red Cornish chickens

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Abstract

An experiment was performed by taking 45 numbers of Red Cornish Chickens to assess their cognitive abilities by virtue of their training in different type of mazes. Birds were randomly assorted into 3 groups with each group having 15 birds each and were maintained on deep litter system. Group-3 birds were trained throughout the training period of 6 weeks (42 days), whereas Group-1 and Group-2 were trained at a particular time period of the training session as mentioned below and then tested in two types of mazes i.e. T-maze and Elevated Base T-maze. A 3-test schedule at the completion of every 2 weeks i.e. Test-1(14th day), Test-2 (28th day), Test- 3(42nd day) was conducted. In Test-1, birds under Group-3 by virtue of their training, performed significantly better ($p<0.05\%$) as compared to Group-1 and Group-2 in both type of mazes i.e. T- maze and Elevated Base T-maze. In Test-2 and Test-3, where other 2 groups were trained for the same, their performance also improved significantly than Test-1. This study clearly depicts that training significantly affects the learning and cognitive ability in Red Cornish birds. The slope of the base of the maze has not affected the food searching capacity of birds in mazes. With the progression of age as observed in Test-2 and Test-3, the performance improved as the efficiency in gathering spatial information and executing the same also increased.

Keywords: Cognition, spatial memory

1. Introduction

Animal cognition has been defined as a collective mechanism, which includes perception, erudition, memorizing, assessment, understanding and acting upon those processes (Ashcraft *et al.*, 2002) [3]. In this process they evolved to better acclimatize and contend with the exterior milieu with a more vibrant and flexible way, rendering them advantage in evolutionary process (Duncan, 2006) [10].

All animal may not have the character of cognition equity but cognition is unquestionably a part of their evolutionary mechanism. Intra-species variation in the standards of cognition always portrays a cognitive superiority among them which always remain a advantage in the adaptation process (Rogers *et al.*, 1995) [24].

Animal welfare has been a vital cog in livestock husbandry now-a-days, as animals are equalised with human being with an egalitarian perspective. Animal cognition gives an impetus into their welfare issues. Training, not only denigrate distress during different husbandry practices (Bassett *et al.*, 2003) [4], but also heightens the ability of the animal to triumph over fear (Laule *et al.*, 2003) [5] and further it helps in the reduction of agonistic behaviour (Bloomsmith *et al.*, 1994) [5]. Another imperative benefit of training is the diminution in the level of etho-anomalies as compared to non-trained ones (Dorey *et al.*, 2009) [9]. Assessment of animal welfare has been a tedious and insightful task to many ethologists irrespective of the livestock system, they are experimenting on.

Spatial learning and memory has been an intriguing field as it raises several critical questions about the process and activities how animals perceive and utilize different information for spatial memory.

In view of the above hypothesis, the current study was designed to evaluate learning and cognitive ability in Red Cornish birds. The investigation was conducted to assess the effect of continuity in training on maze performance i.e. task completing abilities in Red Cornish chickens.

2. Materials and Methods

2.1 Experimentation Location: The experiment work was conducted in the Instructional Livestock Farm Complex, College of Veterinary Science and Animal Husbandry (C.V.Sc. and AH), Odisha University of Agriculture and Technology (OUAT), Bhubaneswar, Odisha.

2.2 Procurement of experimental birds

45 number of day-old Red Cornish chicks were procured as research birds. The birds were collected from the CPDO (Central Poultry Development Organization), East Region, Bhubaneswar, Odisha.

2.3 Management of experimental birds

The research was conducted for six weeks from 14th January to 28th February 2020. Deep litter system of rearing was preferred for the red Cornish birds and all the necessary life supporting arrangements were prepared 1 day before the procurement of chicks. The deep litter space was alienated into three cubicles by use of wire-netting and named according to experimental groups. Identification of the chicks was done by using wing bands. Feeding protocol was performed as per BIS guidelines of broiler feeding. Amprolium was given at prophylactic dose during 22nd-25th day. Vitamin A, D3, E and B complex supplements were given from day-old age to 2 weeks of age for proper development. The birds were vaccinated as per routine protocol.

2.4 Research protocol

Forty-five research birds were randomly categorized in to three groups of 15 birds each as follows.

- **Group-1:** Birds were trained on the 5th and 6th week of the training period.
- **Group-2:** Birds were trained only for 3rd and 4th week of the training period.
- **Group-3:** Birds were trained throughout the experiment i.e. 1st week to 6th week.

2.5 Cognitive Performance Assessment

The cognitive performance ability was assessed on the basis of maze test. Two maze tests were performed namely T-Maze test and Elevated base T-Maze test. Wooden sheets, cardboard and plastic stripes were used to create the Maze models.

2.5.1 T Maze test

The length of the start box was 50 cm and both arms were raised at a distance of 35 cm from the starting box. The sidewall height of the maze was 30 cm high.



Fig 1: T-Maze

2.5.2 Elevated T Maze test

Start box length of T Maze was 50 cm and both arms of the T-maze were in a straight line and 35 cm from the starting box. The height of the sidewall of the maze was 30 cm. Floor of the side arms was elevated 5 cm with respect to start-box

floor with a slope of 40 degree.



Fig 2: Elevated Base T-Maze

2.5.3 Training and testing of the chickens in mazes

The training was conducted from 2nd day onwards in both the mazes, only in Group-3 birds, which were trained throughout the experiment (1stwk- 6thwk). Group-2 birds were trained during the 3rd and 4th weeks only. Group-1 birds were trained during the 5th and 6th weeks only. Birds were trained individually in both the mazes. Duration of training was 5-10 minutes per bird. The training was given on 6:30 am to 7:30 am everyday just before the morning meal. Training was not given on the test days. The duration of time (in second), the birds had taken from the start of their movement in the start box to the time of acquiring of feed in either arm, was recorded as the maze performance

3. Result

3.1 Maze Performance of Red Cornish birds

The performance of Red Cornish birds in mazes were assessed by using two different types of mazes viz. T-Maze and Elevated base T-Maze and the results were depicted below.

3.1.1 T maze Performance of Red Cornish birds

The performance of the Red Cornish birds in the three groups of birds in T-Maze has been demonstrated in Table 3.1, and Fig. 3.1 and 3.2. In test-1, Birds under Group-3 by virtue of their training, performed significantly better ($p<0.05\%$) as compared to Group-1 and Group-2 (98.600 ± 6.362 sec vs. 182.867 ± 5.632 sec in Group-1 and 176.267 ± 7.292 sec in Group-2). In Test -2 conducted on the 28th day of the experiment, Group-3 birds performed significantly ($p<0.05\%$) better ($p<0.05\%$) than Group-2 (64.267 ± 6.772 sec vs. 108.667 ± 5.806 sec of Group-2). In this schedule, the performance of Group-2 was also significantly ($p<0.05\%$) superior with respect to Group-1 birds (108.667 ± 5.806 sec vs. 147.533 ± 7.184 sec). In 3rd schedule, conducted on the 42nd day, Group-3 birds outperformed birds of other 2 groups (49.200 ± 5.823 sec vs. 77.600 ± 6.621 sec of Group-2 and 87.000 ± 5.019 sec of Group-1).

Table 3.1: T Maze Performance of Red Cornish birds (in sec)

	Test-1	Test-2	Test-3
Group 1	182.867aA±5.632	147.533bA±7.184	87.000cA±5.019
Group 2	176.267aA±7.292	108.667bB±5.806	77.600cA±6.621
Group 3	98.600aB±6.362	64.267bC±6.772	49.200cB±5.823

Means with different superscripts in a row (a, b, c) and column (A, B, C) differ significantly ($P<0.05$).

Among all the groups, there was a common trend that showed a significant and gradual improvement in performance from Test-1 (Conducted on the 14th day) to Test-2 (conducted on the 28th day) and similar trend was observed from test-2 to test-3(Conducted on the 42nd day) results.

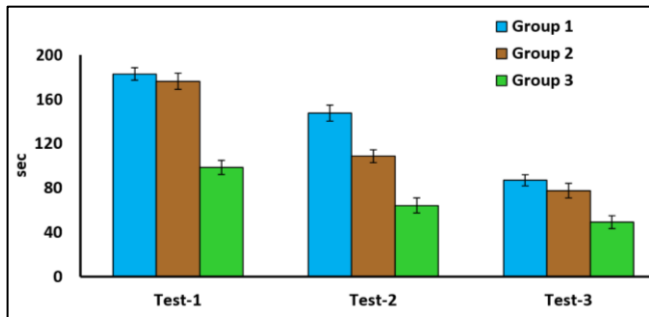


Fig 3: Performance of birds in T-Maze with respect to training

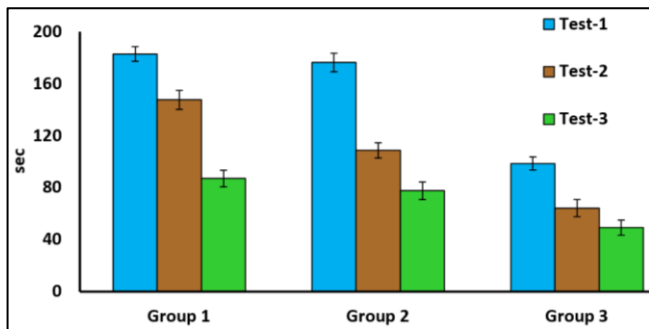


Fig 4: Performance of birds in T-Maze with respect to test day

3.1.2 Elevated T maze Performance of Red Cornish birds

The performance of the Red Cornish birds among the three groups of birds in Elevated T- Maze has been demonstrated in Table 3.2 and Fig. 3.3 and 3.4. Although the birds took longer time period to complete the tasks but the trend observed was almost similar to the T-Maze test. Birds under Group-3 by virtue of their training, performed significantly better ($p<0.05\%$) as compared to Group-1 and 2 (109.467 ± 6.302 sec vs. 190.267 ± 6.189 sec of Group-1 and 182.333 ± 6.265 sec of Group-2). In Test-2 conducted on the 28th day of the experiment, Group-3 birds performed significantly better ($p<0.05\%$) than Group-2 ($71.533\text{sec}\pm5.546$ vs. $120.133\text{sec}\pm7.837$ sec of Group-2). In this schedule, the performance of Group-2 was also significantly superior with respect to Group-1 birds (120.133 ± 7.837 sec vs. 153.667 ± 7.749 sec). In 3rd schedule, conducted on the 42nd day, Group-3 birds outperformed birds of other 2 groups (50.600 ± 4.032 sec vs. 81.533 ± 5.482 sec of Group-2 and 89.667 ± 4.911 sec of Group-1). Among all the groups, there was a common trend that showed significant and gradual improvement in performance from test-1(conducted on the 14th day) to test-2 (conducted on the 28th day) and similar trend was observed when test-2 results to test-3 (conducted on the 42nd day).

Table 1: Elevated T Maze Performance of Red Cornish birds (in sec)

	Test-1	Test-2	Test-3
Group 1	190.267aA±6.189	153.667bA±7.749	89.667cA±4.911
Group 2	182.333aA±6.265	120.133bA±7.837	81.533cA±5.482
Group 3	109.467aB±6.302	71.533cB±5.546	50.600cB±4.032

Means with different superscripts in a row (a, b, c) and column (A, B, C) differ significantly

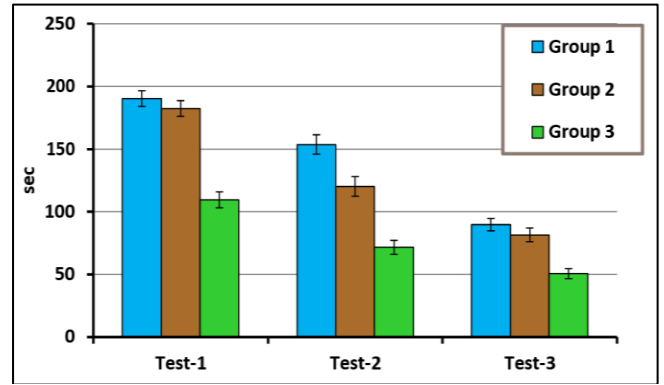


Fig 5: Performance of birds in Elevated T-Maze with respect to training

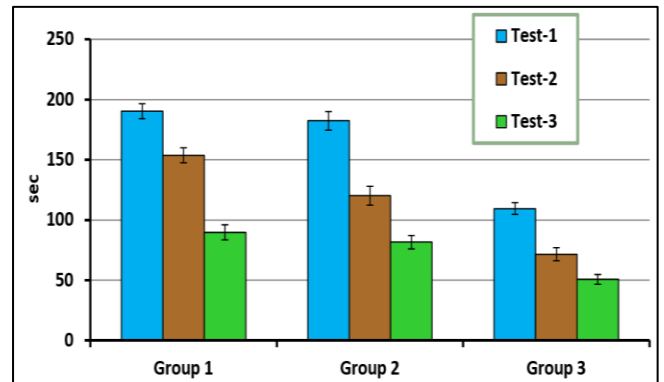


Fig 6: Performance of birds in elevated T-Maze with respect to test day

4. Discussion

4.1 Performance of Red Cornish birds in different mazes for cognitive ability assessment

To assess the cognitive performance of red Cornish bird’s two different types of mazes were used.

4.1.1 Performance of birds in T maze

In all three test days i.e. 14th, 28th, 42nd days, birds of Group-3 performed significantly ($p<0.05\%$) better as compared to other two groups. Training played a vital role in acquiring spatial memory which had produced a significantly superior performance. With the progression in time, the birds evolved an improved spatial sense, for the location of feed in different arms of the maze which was reflected in their improved performance. As Group-3 birds were trained the longest i.e. from the first day of training till the end of the experiment, their performance was best among all the three groups. In Test-1, conducted on the 14th day, Group-1 and Group-2 birds showed similar performance as both were not trained for mazes. In Test-2 conducted on the 28th day, there was a significant ($p<0.05\%$) improvement as compared to the Test-1 performance in all the 3 groups. This might be attributed to superior spatial memory with the advancement of age. In Test-2, Group-1 performed the worst in comparison to other 2 groups. As Group-2 birds were trained from 14th day to 28th day, their performance not only increased from Test-1 but also showed better results than Group-1 birds. Group-3 birds which were continuously trained had the best performance in Test-2 also. In Test-3, there was a significant ($p<0.05\%$) improvement in the Test performances of all the 3 experimental groups. Birds from Group-1 and Group-2 showed a similar performance level which attributed to the fact that birds from Group-1 received similar training of 2

weeks from 28th-42nd day. Group-3 birds had best performance as the duration of training was longest in that group. This might be inferred that continuous training from early life resulted in higher spatial memory and superior performance.

Birds learned a particular type of turning near the arm to procure the food or specifically go for a particular environmental cue as hypothesized by McKintosh *et al.* (1965)^[20]. Vallortigara and Andrew (1994)^[11], McKenzie *et al.* (1998)^[19] also accounted that chicks had a variable preference for different ambient cues which either had a strong or weak impact on them. They showed more inclined performance towards familiar or non-threatening impulse than the unfamiliar or threatening stimuli. The results obtained in the current experiment was significantly higher than the range of 4 to 90 seconds as recorded by Marina and Jones (2000)^[18], which might be due to variation in breed or genetic variations.

With the progression of age, performance improved as the efficiency in gathering spatial information and executing the same also increased. The present study also found the correlation between the cognitive modifications as birds always try to maintain coherent groups and modify themselves accordingly (Dunbar, 2001)^[12].

4.1.2 Performance of birds in Elevated Base T-Maze

In all the test days i.e. 14th, 28th, 42nd days, birds from Group-3 birds performed significantly ($p < 0.05\%$) better as compared to rest 2 groups and the results obtained was marginally higher than the T maze, depicted that the birds had no problem in acquiring the food and performed significantly in moving through a elevated route to procure food. With training the birds got familiar with it and created a non-threatening impetus towards it. This also validated the theory of Dunbar (2001)^[12], who postulated the impact of grouping of birds on the learning and developing spatial memory. This also substantiated that, there existed a negative correlation between social complexity and cognitive capabilities (Dunbar, 2001)^[12].

Atkinson and Shiffrin (1971)^[4] also opined that the idiosyncrasy arising in developing working memory capacity was mainly due to the primary memories acquired by the birds. As both intelligent and dumb birds had different cognitive aptitudes thus acquired diverse working memory. It also supported the propositions of Panigrahy *et al.* (2017)^[17] who reported that, the Performance of birds in T-maze had improved ($p < 0.05$) with increase in the age. Sex of birds or grouping system did not affect the performance of birds in maze performance.

5. Conclusion

By virtue of the results in different maze tests, it has been found that Training played a vital role in acquiring spatial memory which had produced a significantly superior performance among the different groups. The slope of the base (in case of elevated base T-Maze) has no-significant effect on the food searching capacity of birds in mazes. With the progression of age, performance improved as the efficiency in gathering spatial information and executing the same for completing the test successfully also increased. The present study also found the correlation between the cognitive modifications as birds always try to maintain coherent groups and modify themselves accordingly. Further, exclusive studies should be conducted for concrete establishment of the correlation between the training and task completing abilities of the birds.

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