# Sound Exposure Effects towards Ross Broilers Growth Rate

Rashidah Ghazali, Herlina Abdul Rahim, Mashitah Shikh Maidin, Shafishuhaza Sahlan, Noramli Abdul Razak

*Abstract*—Sound exposure effects have been investigated by broadcasting a group of broilers with sound of Quran verses (Group B) whereas the other group is the control broilers (Group C). The growth rate comparisons in terms of weight and raw meat texture measured by shear force have been investigated. Twenty-seven broilers were randomly selected from each group on Day 24 and weight measurement was carried out every week till the harvest day (Day 39).Group B showed a higher mean weight on Day 24 (1.441 ± 0.013 kg) than Group C. Significant difference in the weight on Day 39 existed for Group B compared to Group C ($p < 0.05$). However, there was no significant ($p > 0.05$) difference of shear force in the same muscles (breast and drumstick raw meat) of both groups but the shear force of the breast meat for Group B and C broilers was lower ($p < 0.05$) than that of their drumstick meat. Thus, broadcasting the sound of Quran verses in the coop can be applied to improve the growth rate of broilers for producing better quality poultry.

*Keywords*—Broilers, sound, shear force, weight.

## I. INTRODUCTION

MUSIC or sound has been known to have a relaxing and antidepressant effect on humans, mammals and birds. Researches had been done by experimenting various sound, music or noise exposure towards cow, pig and poultry.

Ueteka et al. showed that music (background noise + music: 70 dB versus background noise: 60 dB) has a stimulatory effect on the voluntary approach of dairy cows to an automatic milking system [1]. Reference [2] reported that dairy cows produce more milk when exposed to music than to noise generated by the milking machine. In contrast, investigation of music played between 70 dB and 80 dB during the weaning and restraint has no effect on piglets [3]. Campo et al. stated that the hens exposed to specific music stimulus were more fearful than control hens [4]. The research reported that specific noise stimulus (90 dB versus 65 dB) caused stress and fear in laying hens while specific classical music stimulus (75 dB versus 65 dB) had a negative effect on their fearfulness.

Reference [5] illustrated that regular exposure to music, whether country, classical or jazz, for 8 hours reduced the heterophil-to-lymphocyte ratio and grooming (stress indicators), while it stimulated feeding and head shaking in laying hens. The study conducted by Gvarhayu et al. on the combined effects of music, environmental enrichment and filial imprinting by intermittently (1hour on / 1 hour off) using low-level classical music (Vivaldi's *Four Seasons*) shows a decreasing effect on broiler chick fearfulness [6], [7]. The experimented chicks were exposed to the sound of background noise and music to the maximum of 75 dB while the control group was only had been exposed to a background noise level of 65 dB. The experimented chicks were less fearful and fed and weighed radically more than the control chicks. On the other hand, Christensen and Knight did not find any significant outcome on feed consumption when exposing meat-type chicks to two different sound levels (70 dB and 85 dB) and different kinds of music continuously for 12 hour each day [8].

Studies on the relationship between music stimulus and its effect on the broilers' weight and raw meat texture are scarce and there are no previous studies on the relationship between playing Quran verses and the effect on chicken weight. It was hypothesized that the experimental broilers (the group of broilers played the Quran verses) would have a better growth rate in terms of weight and raw meat texture shear force compared to the control group. Therefore, the purpose of the present study was to analyse the effect of on broiler weight and raw meat texture auditory enrichment through broadcasting Quran verses using Volodkevich Bite Jaws Texture Analyser.

## II. MATERIALS AND METHODS

### A. Subjects

Two groups of broiler Ross chicks were bred commercially in two different coops in a farm. The experimental Group B was exposed to the sound of the Quran verses and background noise (animal voices and fans), ranging from 70 dB(A) to the maximum of 75 dB(A) sound level [7] for 8 hours (0800 to 1300 and 1400 to 1700) every day until the harvest day (Day 39). The control group was housed with background noise (animal voices and fans), with a noise level of 65 dB(A) maximum (ranging from 60 to 65 dB(A)).

The sound of the Quran verses (frequency of 22.05 kHz) was relayed using a DVD player and amplified using a Cody stereo AV-613 amplifier, which was connected to the speakers. Two speakers were attached to the pillars above the chickens at each end of the coop. The decibel level of sounds was tested using a VICTOR 824C digital sound level meter [9] to ensure it remained close to 75 dB(A).

The temperature of each coop was measured and adjusted in order to make sure that the temperatures were all the same. All the chicks were reared under standard temperatures that were

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controlled by electric or gas heaters (33–34°C at chick level for week 1, followed by a reduction of 2°C/week until the temperature reached 25–28°C at 6 weeks of age).

Broilers from all chicken groups were fed with commercial pellet diets produced by the Huat Lai Feedmill Sdn. Bhd. Detailed compositions of the feeds for broilers in the broadcasting and control group are shown in Table I.

TABLE I
BROILER'S FOOD COMPOSITION

| | Broiler Starter Crumble | Broiler Grower Pellet |
|---|---|---|
| **Weeks of feeding** | *0–2* | *3–6* |
| **Chemical composition** | | |
| Crude protein (%) | 21–23 | 19–21 |
| Crude fibre, max (%) | 5.0 | 5.0 |
| Crude fat, max (%) | 5.0 | 5.0 |
| Moisture, max (%) | 13.0 | 13.0 |
| Ash, max (%) | 8.0 | 8.0 |
| Calcium (%) | 0.8–1.2 | 0.8–1.2 |
| Phosphorus (%) | 0.6–1.0 | 0.6–1.0 |

Before reaching Day 24, the broilers were placed in the brooding fence to keep them warm and no tagging on the broilers was allowed. At the age of 24 days, the broilers were released from the brooding period. Twenty-seven broilers from each of the two groups were randomly picked and weighed. Each broilers had two separate identification tags affixed to different body parts, namely different wing tag colours sprayed on Day 24 and a numbered identification tag were tied, using cable ties, around the broiler legs on Day 39. The weight gains of the broilers were recorded weekly until the harvest day.

*B. Meat Samples*

At the age of 39 days, broilers from all three groups were slaughtered. The animal handling and slaughter process procedure were carried out following the guidelines of Malaysian Standard 1500:2009 on halal food production, preparation, handling and storage respectively [10]. Afterwards, the left-side breasts (pectoralis major muscle) were taken and vacuum-packed and kept frozen under -20°C temperature [11]. The breast meats were thawed at a temperature of 4°C overnight before the experiment day [12]-[13]. The next day, the raw breast meats from each chicken carcass were cut into rectangular blocks with a dimension of 10 mm-thick x10 mm-wide x 20 mm-long with the long axis in the direction of the muscle fibres [13]-[15]. Seven blocks samples from each raw breast meat and six samples from both raw drumsticks were cut for the texture measurement. Raw meat texture measurements were performed rather than cooked meat because cooking increases the hardness of the meat [16]and moreover, there are many different methods of cooking applied by consumers: for example, boiling [17], grilling [16], [18], [19] and marinating [20].

*C. Volodkevich Bite Jaws Texture Analyzer*

The textural assessment of raw broiler meat samples was conducted using a computer-assisted TA.HD plus Texture Analyser (Stable Micro Systems, UK) fitted with Volodkevich bite jaws set with a setting compression for the test mode, pre-test speed of 0.2cm/sec, test speed of 0.2cm/sec, post-test speed of 0.2cm/sec distance of 0.5cm and trigger type, auto [13]-[15]. Each previously cut raw chicken meat samples was placed into the texture analyser slot before measurement. Each chicken meat block was sheared and compressed once in the centre and perpendicular to the longitudinal direction of the fibres using a Volodkevich bite jaw (stainless steel probe shaped like an incisor) which was fitted to a TA-HD plus texture analyser (Stable Micro Systems, UK) at an angle of 90° [13]-[15]. The sheared force data was recorded in kilograms (kg). The data were then saved and imported to an Excel file for analysis.

III. RESULTS AND DISCUSSION

All data from the chicken weighing records and the shear force measurements from Volodkevich Bite Jaws Texture Analyser were loaded into Microsoft Office Excel 2007. Data of the both groups of broilers were compared using the statistical one-way analysis of variance (ANOVA) [21] using IBM Statistical Package for Social Science version 21.0 (SPSS inc., Chicago, Illinois, U.S.A). Statistical significance was indicated at 95% confidence level. All data were expressed as means ± SE (Standard Error of the Mean).

One way ANOVA is used to test whether there are any significant differences between the means of two independent groups. Before commencing this approach, the dependent variable should be approximately normally distributed [22].

The distribution of data was assessed based on the Shapiro–Wilk test of normality, where the p-value of the Shapiro–Wilk test needs to be greater than the standard significance level 0.05 to assume that data are distributed normally (bell-shaped) [22]. From Table II, the significance / p- value of Shapiro–Wilk test are all greater than the standard significance level 0.05. These imply that it is acceptable to assume that the distribution data of factors for all groups are normal.

After applying the normality test, variables need to be tested with Levene's test for homogeneity of variances [22].

TABLE II
SHAPIRO-WILK TEST OF NORMALITY

| Factor | Group | Shapiro-Wilk | | |
|---|---|---|---|---|
| | | Statistic | df | Sig. |
| Weight Day 24 (kg) | Group B | 0.959 | 27 | 0.349 |
| | Group C | 0.973 | 27 | 0.680 |
| Weight Day 39 (kg) | Group B | 0.935 | 27 | 0.090 |
| | Group C | 0.930 | 27 | 0.068 |
| Weight Gain From Day 24 to Day 39 (kg) | Group B | 0.961 | 27 | 0.386 |
| | Group C | 0.934 | 27 | 0.087 |
| Shear Force Breast Meat (kg) | Group B | 0.959 | 27 | 0.358 |
| | Group C | 0.978 | 27 | 0.809 |
| Shear Force Drumstick Meat (kg) | Group B | 0.977 | 27 | 0.783 |
| | Group C | 0.927 | 27 | 0.057 |

From the Levene's statistic, if the significance / p-value is greater than 0.05, it is acceptable to assume that the variances are homogeneous (same), otherwise, if the p-value is smaller

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than 0.05, then the assumption of equal variances is violated. From Table III, the variances are homogeneous for Weight Day 24 and Shear Force Drumstick Meat , but for Weight Day 39, Weight Gain from Day 24 to Day 39 and Shear Force Breast Meat and indicated that the variances are significantly different, or in other words, the assumption of equal variances is violated.

TABLE III
TEST OF HOMOGENEITY OF VARIANCES

| Factor | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|
| Weight Day 24 (kg) | 0.193 | 1 | 52 | 0.662 |
| Weight Day 39 (kg) | 5.321 | 1 | 52 | 0.025 |
| Weight Gain From Day 24 to Day 39 (kg) | 14.019 | 1 | 52 | 0.000 |
| Shear Force Breast Meat (kg) | 8.910 | 1 | 52 | 0.004 |
| Shear Force Drumstick Meat (kg) | 0.177 | 1 | 52 | 0.676 |

From the ANOVA table in Table IV, the p-value which is less than 0.05 ($p < 0.05$) indicated a significant difference exists in Weight Day 24 and Weight Day 39 between Group B and Group C. The Weight Gain from Day 24 to Day 39, shear force of breast meat and drumstick meat show a high significance value of more than 0.05, ($p > 0.05$) so there are no differences between groups.

The comparison of growth rate of weights and shear force between broilers from Group B and C is shown in Table V. For the chicken live weight measured on Day 24, ANOVA analysis showed significant differences ($p < 0.05$) appeared between group B and group C (1.441 ± 0.013 vs 1.381 ± 0.015). Meanwhile, for the chicken live weight on the Day 39 (harvest day), differences were observed between group B and C (2.944 ± 0.025 vs 2.817 ± 0.039). However, there was no significant difference ($p > 0.05$) between group B and group C for weight gain from Day 24 to Day 39.

TABLE IV
ANALYSIS OF VARIANCE (ANOVA)

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Weight Day 24 (kg) | Between Groups | 0.047 | 1 | 0.047 | 9.258 | 0.004 |
| | Within Groups | 0.266 | 52 | 0.005 | | |
| | Total | 0.314 | 53 | | | |
| Weight Day 39 (kg) | Between Groups | 0.217 | 1 | 0.217 | 7.504 | 0.008 |
| | Within Groups | 1.505 | 52 | 0.029 | | |
| | Total | 1.723 | 53 | | | |
| Weight Gain From Day 24 to Day 39 (kg) | Between Groups | 0.062 | 1 | 0.062 | 2.679 | 0.108 |
| | Within Groups | 1.197 | 52 | 0.023 | | |
| | Total | 1.259 | 53 | | | |
| Shear Force Breast Meat (kg) | Between Groups | 0.017 | 1 | 0.017 | 1.040 | 0.313 |
| | Within Groups | 0.856 | 52 | 0.016 | | |
| | Total | 0.874 | 53 | | | |
| Shear Force Drumstick Meat (kg) | Between Groups | 0.159 | 1 | 0.159 | 2.408 | 0.127 |
| | Within Groups | 3.429 | 52 | 0.066 | | |
| | Total | 3.588 | 53 | | | |

The significant differences for group B in terms of chicken live weight measured on Day 24 and Day 39 proved that the sound of Quran verses helped to reduce the stress of the broilers. From daily observations, it was found that the broilers in Group B more calm in handling the stress due to the environment and temperature and thus increase the feeding of the chickens. The finding in this current study agreed with results reported in previous researches about the association between the sound / music treatment and less stressfulness demonstrated by the chickens.

Ladd et al. reported that the reading of heterophil-to-lymphocyte ratio (stress indicator) for experimented hens that listen to country music for 8 hours was lower than the control, plus the music accelerated the feeding of the hens [5]. Additionally, Gvarhayu et al. exposed the experimental chicks to low-level classical music to a maximum of 75 dB (background noise plus music) while the control chicks were exposed to an ambient noise level of 65 dB (fans and chicks noise) [6], [7]. The results obtained revealed that the treated chicks were less fearful and fed and weighed significantly more than the control chicks. It is true that it is difficult to come to a general conclusion across experiments from different authors, as music differs widely with regard to the rhythm, instrument and frequency. But the decibel (dB(A)) value of the sound exposure used for this research was the same as in the other previous researches [1], [4]-[7].

TABLE V
COMPARISONS OF BROILER'S GROWTH RATE

| Factor | Group | N | Mean ± SE | S.D. | Minimum | Maximum |
|---|---|---|---|---|---|---|
| Weight Day 24 (kg) | B | 27 | 1.441 ± 0.013[a] | 0.067 | 1.340 | 1.580 |
| | C | 27 | 1.381 ± 0.015[b] | 0.077 | 1.225 | 1.510 |
| Weight Day 39 (kg) | B | 27 | 2.944 ± 0.025[a] | 0.129 | 2.715 | 3.130 |
| | C | 27 | 2.817 ± 0.039[b] | 0.203 | 2.440 | 3.090 |
| Weight Gain Day 24 to Day 39 (kg) | B | 27 | 1.503 ± 0.020 | 0.103 | 1.305 | 1.700 |
| | C | 27 | 1.436 ± 0.036 | 0.188 | 1.080 | 1.710 |
| Shear Force Breast Meat (kg) | B | 27 | 0.643 ± 0.030[x] | 0.156 | 0.397 | 0.947 |
| | C | 27 | 0.679 ± 0.018[x] | 0.093 | 0.522 | 0.868 |
| Shear Force Drumstick Meat (kg) | B | 27 | 0.910 ± 0.049[y] | 0.255 | 0.372 | 1.434 |
| | C | 27 | 0.801 ± 0.050[y] | 0.258 | 0.373 | 1.221 |

[a,b] Means within a column with different superscripts are significantly different at $p < 0.05$.
[x,y] Means within columns with different superscripts are significantly different at $p < 0.05$.
B: Broadcasting group; C: Control group.
S.D: Standard Deviation.
N: Number of Subjects

Although there was no significant difference ( $p > 0.05$) of shear force in the breast and drumstick meats between the both groups, the shear force of the breast meats of group B and C was lower ($p < 0.05$) than their drumstick meats. It is known that the broiler consists of two types of meat; white and red meat. The breast meat of chicken is the white meat while the leg (thigh and drumstick) is red meat [23]. The shear force for breast meat is lower than red meat because white meat has less myoglobin (an oxygen-carrying protein) [24] compared to the

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red meat. The legs are used to support the weight of the chickens while they move. The leg muscles contain large amounts of myoglobin proteins which help to transport the oxygen more efficiently for aerobic respiration [24]. In contrast the white meat, generally found within the breasts of the birds, are used for quick bursts of power which requires little of the meat-darkening myoglobin.

Linear regression plot of Weight Day 39 against Weight Gain from Day 24 to Day 39 for Group B and C were shown in Figs. 1 and 2. From the plot, Group B shows high correlation coefficients with the highest value of R-squared which is 0.853 compared to Group C with 0.683.
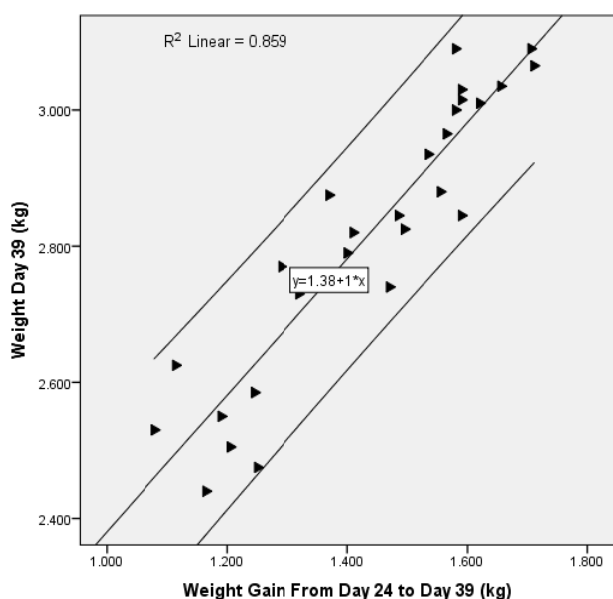


Fig. 1 Linear regression plot Weight Day 39 versus Weight Gain from Day 24 to Day 39 for Group B
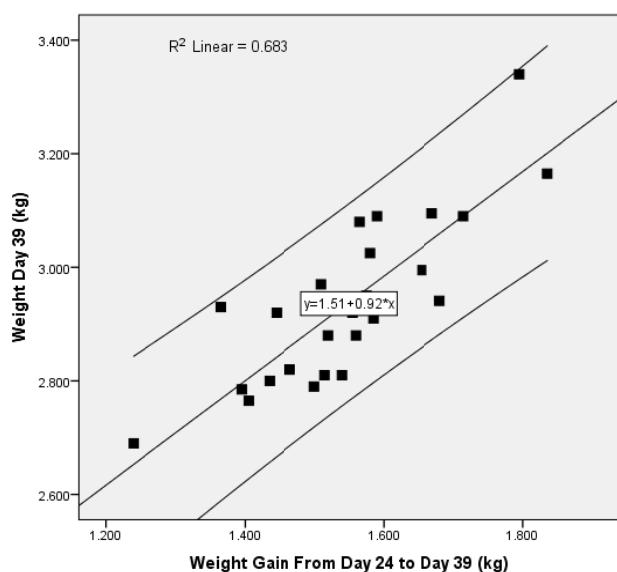


Fig. 2 Linear regression plot Weight Day 39 versus Weight Gain from Day 24 to Day 39 for Group C

From the Model Summary in Table VI, the R-square value for Group B is 85.9% and Group C is 68.3% which implies that the simple linear regression models for the Weight Gain from Day 24 to Day 39 versus Weight Day 39 are satisfactorily adequate. The correlation coefficient – R for Group B is 0.927 and Group C is 0.827 indicate a strong positive linear relationship between Weight Gain from Day 24 to Day 39 and Weight Day 39.

TABLE VI
MODEL SUMMARY

| Group | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| B | 0.927 | 0.859 | 0.853 | 0.077983 |
| C | 0.827 | 0.683 | 0.671 | 0.082725 |

TABLE VII
COEFFICIENTS FOR GROUP B AND C

| Group | | U.C. | | S.C. | t | Sig. | 95.0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound |
| B | Constant | 1.378 | 0.118 | | 11.700 | 0.0 | 1.135 | 1.620 |
| | Weight Gain From Day 24 to Day 39 (kg) | 1.002 | 0.081 | 0.927 | 12.322 | 0.0 | 0.835 | 1.170 |
| C | Constant | 1.511 | 0.194 | | 7.779 | 0.0 | 1.111 | 1.911 |
| | Weight Gain From Day 24 to Day 39 (kg) | 0.921 | 0.125 | 0.827 | 7.345 | 0.0 | 0.663 | 1.179 |

[a] Dependent Variable: Weight Day 39 (kg)
U.S: Unstandardized Coefficients.
S.C: Standardized Coefficients.

From the Coefficients table in Table VII, it can be seen that the slope for all broiler groups are significantly not zero as the Sig., or p-value for the slope statistic is very small ($<0.01$).The estimated least-squares lines are illustrated in (1) and (2).

$$\text{Group B: } \hat{y} = 1.378 + 1.0x \tag{1}$$

$$\text{Group C: } \hat{y} = 1.511 + 0.921x \tag{2}$$

The death rate of the chickens in the entire coop for group B was less than that of group C. From the observation, the experimented group B broilers had a death rate of less than 5% compared with the death rate of more than 8% in group C. This proved that the experiment broilers had less risk of dying compared to the control broilers.

## IV. CONCLUSION

Findings from this research indicate that the exposure of the sound of Quran verses produced better broilers compared to the control. These experimented broilers weighed more and gained more weight from the initial day of weighing until the harvest day. From observation, these experimented broilers were calm and not disturbed by the environment stress (noise of the fan and chickens and the heat) thus their feeding improved and they stayed healthy, with a lower death rate compared to the control broilers. From the linear relationship

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between Weight Gain from Day 24 to Day 39 and Weight Day 39 it is proved that the experimented broilers show high accuracy than the control broilers. Therefore, the method of broadcasting the sound of Quran verses in the coop can be applied to improve the growth rate of farmed broilers, thus increasing the profit of the farmers.

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