

SOUND EXPOSURE AND WATER SUPPLY MODIFICATION EFFECT TOWARDS THE ROSS BROILERS GROWTH RATE

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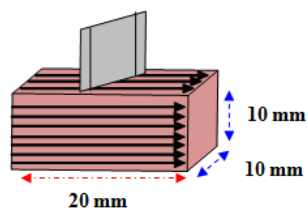
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Graphical abstract



Abstract

Previous research about the exposure of Mozart music and noise and the effects towards the feeding, growth rate and the stress level of the broilers were explored. Music has the ability to have a relaxing and antidepressant effect on humans, mammals and birds. Reports that music calms animals and improves productivity appear in commercial journals. The present study investigated the growth rate comparisons between the experimented broilers (Group A: water supply modification group; Group B: sound exposure group) and the control broilers (Group C: control group) in terms of weight and raw meat texture measured by shear force. The water supply modification group was given 12 litres of Yasin water twice per day while the sound exposure group were broadcasted with sound of Quran verses. Twenty-seven broilers were randomly selected from each group on Day 24 and weight measurement was carried out every week until the harvest day (Day 39). Group B showed a higher mean weight on Day 24 (1.441 ± 0.013 kg) than Group A and C. Significant difference in the weight on Day 39 existed for both Group A and 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 the three groups but the shear force of the breast meat for Group A, B and C broilers was lower ($p < 0.05$) than that of their drumstick meat. Broadcasting the sound of the Quran verses in the coop and adding Yasin water to the broilers' drink can be applied to improve the growth rate of broilers for producing better quality poultry.

Keywords: Broilers, sound, shear force, Volodkevich bite jaws, weight

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1.0 INTRODUCTION

Research by Ueteka *et al.* (1997) 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]. In contrast, music played between 70 dB and 80 dB during the weaning and restraint has no effect on piglets [2]. Campo *et al.* (2005) stated that the hens exposed to specific music stimulus were more fearful than control hens. The research reported that

specific noise stimulus (90 dB versus 65dB) caused stress and fear in laying hens while specific classical music stimulus (75dB versus 65dB) had a negative effect on their fearfulness [3].

The combined effects of music, environmental enrichment and filial imprinting by intermittently (1 hour on /1 hour off) using low-level classical music (Vivaldi's *Four Seasons*) shows a decreasing effect on broiler chick fearfulness [4, 5]. 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, fed and weighed radically more than the control chicks. On the other hand, Christensen and Knight (1975) 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 [6].

According to the *Miracle of water* written by Masaru Emoto, water demonstrates a unique role in transporting the natural vibration of words [7]. When water was exposed to good words, beautiful crystals were produced, while ugly crystals resulted when the water was exposed to bad words [7]. The experiments were conducted by freezing water to a temperature of 25°C and then placing the frozen water under the microscope equipped with a camera to photograph the crystal shape structures before melting [8 - 10]. By using the high-speed photography, the direct consequences of negative thoughts and the thoughts of love and appreciation on the formation of water crystals were revealed.

In addition, Masaru Emoto conducted experiments with water and music by exposing the water to a volume at which a person might normally listen to music [8, 10]. Beethoven's *Pastoral Symphony*, with its bright and clear tones, resulted in beautiful and well-formed crystals. Mozart's *40th Symphony*, a graceful prayer to beauty, created crystals that were delicate and elegant [8]. Masaru Emoto also performed a test on the water by playing a tape of Quran verses [9]. It was characteristic in being sung sonorously without any musical accompaniment. The crystal produced turned out to have a very symbolic design. On the surface, water may look the same but not on the inside. Water crystals show that appearances can be misleading, thus it is useless to rely on the normal way of looking at something. Instead, the inside of water needs to be concentrated on. It is scientifically proven that water is affected by what is recited over it. Surah Yasin is the heart of the Quran. Surah Yasin provides Shifa (cures) from all physical illness such as fevers, swellings, aches, blindness and insanity [11]. Yasin water is water that has been read or recited with Surah Yasin. Yasin water has been tested on chickens to identify the differences in weight and the tenderness of the chicken meat.

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 given Yasin water and 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, and a water treatment, using Volodkevich Bite Jaws Texture Analyser.

2.0 MODEL DESCRIPTION

Three groups of broiler Ross chicks were bred commercially in three different coops in a farm. There were two experimental groups, Group A and B. Group A was given 12 litres of Yasin water twice per day mixed with the drinking water in the tank. Group B was exposed to the sound of the Quran verses and background noise (animal voices and fans), to the maximum of 75 dB(A) sound level [5] for 8 hours (0800 to 1300 and 1400 to 1700) every day until the harvest day. The control group, Group C was housed with background noise (animal voices and fans), with a noise level ranging from 60 to 65 dB(A) and not given Yasin water. The sound of the Quran verses with 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 sound was tested using a VICTOR 824C digital sound level meter [12] to ensure the sound 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 temperature of 33–34°C at for the first week, followed by a reduction of 2°C/week until the temperature reached 25–28°C at 6th weeks of age. The temperature were controlled by electric or gas heaters. Broilers in all groups were fed with commercial pellet diets produced by the Huat Lai Feedmill Sdn. Bhd. as in Table 1.

Table 1 Broiler 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 chickens were released from the brooding period. Twenty-seven chickens from each of the three groups were randomly picked and weighed. Each chickens 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 chicken legs on Day 39. The weight gains of the chickens were recorded weekly until the harvest day.

At the age of 39 days, 27 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 [13]. Afterwards, the left-side breasts (*pectoralis* major muscle) and two drumsticks were taken and vacuum-packed and kept frozen under -20°C temperature [14]. The broiler meats were thawed at a temperature of 4°C overnight before the experiment day.

The next day, the raw broiler 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 [15, 16]. Seven blocks samples from each raw breast meats 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 [17] and moreover, there are many different methods of cooking applied by consumers: for example, boiling [18], grilling [17, 19, 20] and marinating [21].

The textural assessment of raw broiler meat samples was conducted using TA.HD plus Texture Analyser (Stable Micro Systems, U.K.) fitted with Volodkevich bite jaws which is stainless steel probe shaped like an incisor. The texture analyser was 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. Each previously cut raw broiler meat samples was placed into the texture analyser slot before measurement. Each broiler meat block was sheared and compressed once in the centre and perpendicular to the longitudinal direction of the fibres at an angle of 90° [16]. The sheared force data was recorded in kilograms (kg).

3.0 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 three groups of chickens were compared using the statistical one-way analysis of variance (ANOVA) [22] 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 \pm SE (Standard Error of the Mean).

One way ANOVA is used to test whether there are any significant differences between the means of two or more than two independent (unrelated) groups. Before commencing this approach, the dependent variable should be approximately normally distributed [23].

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) [23]. From Table 2, the significance or 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 [23].

Table 2 Shapiro–Wilk Tests of Normality

Factor	Group	Shapiro-Wilk		
		Statistic	df	Sig.
Weight Day 24 (kg)	A	.952	27	.241
	B	.959	27	.349
	C	.973	27	.680
Weight Day 39 (kg)	A	.946	27	.175
	B	.935	27	.090
	C	.930	27	.068
Weight Gain From Day 24 to Day 39 (kg)	A	.980	27	.852
	B	.961	27	.386
	C	.934	27	.087
Shear Force Breast Meat (kg)	A	.967	27	.515
	B	.959	27	.358
	C	.978	27	.809
Shear Force Drumstick Meat (kg)	A	.933	27	.083
	B	.977	27	.783
	C	.927	27	.057

From the Levene's statistic in Table 3, if the significance is greater than 0.05, it is acceptable to assume that the variances are homogeneous (same), otherwise, if the significance is smaller than 0.05, then the assumption of equal variances is violated. 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 3 Test of Homogeneity of Variances

Factor	Levene Statistic	df1	df2	Sig.
Weight Day 24 (kg)	.419	2	78	.660
Weight Day 39 (kg)	3.547	2	78	.034
Weight Gain From Day 24 to Day 39 (kg)	7.559	2	78	.001
Shear Force Breast Meat (kg)	7.697	2	78	.001
Shear Force Drumstick Meat (kg)	.256	2	78	.775

From the ANOVA table in Table 4, the p-value which is less than 0.05 ($p < 0.05$) indicated a significant difference exists in Weight Day 24, Weight Day 39 and Weight Gain from Day 24 to Day 39 between the three groups. The 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. Even though ANOVA provides information about the existence of significant difference between groups, it did not reveal which of the three groups is actually different. Therefore, the test needs to be continued with a post hoc test.

Table 4 One-Way ANOVA

Factor		Sum of Squares	df	Mean Square	F	Sig.
Weight Day 24 (kg)	Between Groups	.056	2	.028	4.989	.009
	Within Groups	.440	78	.006		
	Total	.496	80			
Weight Day 39 (kg)	Between Groups	.267	2	.134	5.095	.008
	Within Groups	2.046	78	.026		
	Total	2.313	80			
Weight Gain From Day 24 to Day 39 (kg)	Between Groups	.163	2	.081	3.889	.025
	Within Groups	1.633	78	.021		
	Total	1.795	80			
Shear Force Breast Meat (kg)	Between Groups	.017	2	.009	.638	.531
	Within Groups	1.059	78	.014		
	Total	1.076	80			
Shear Force Drumstick Meat (kg)	Between Groups	.176	2	.088	1.277	.285
	Within Groups	5.380	78	.069		
	Total	5.556	80			

Post hoc tests can only be carried out if one-way ANOVA shows significant difference in the factors. From Levene's test in Table 3, Weight Day 24 shows p-value equal to 0.66 that is greater than 0.05 and it is acceptable to assume that the variances are homogeneous. Thus, for post hoc tests with equal variances assumed, Tukey can be used [23]. Meanwhile, for a post hoc test with non-equal variances assumed, Games-Howell is used for the Weight Day 39 and Weight Gain from Day 24 to Day 39, since the p-value for Levene's test is smaller than 0.05. Instead, the shear force of breast and drumstick meat show high significance value of more than 0.05 in one-way ANOVA, so a post hoc test cannot be carried out.

The comparison of physical characteristics of weights and shear force between broilers from group A, B and C are shown in Table 5. For the chicken live weight measured on Day 24, the Tukey's HSD post hoc analysis showed significant differences ($p < 0.05$) appeared between group B and group A (1.441 ± 0.013 vs. 1.389 ± 0.016) and 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 A and group C (2.933 ± 0.028 vs. 2.817 ± 0.039) and between group B and C (2.944 ± 0.025 vs. 2.817 ± 0.039). There was a significant difference ($p < 0.05$) in weight gain between group A and group C (1.53 ± 0.14 vs. 1.42 vs. 0.21) measured from Day 24 to Day 39.

However, there was no significant difference ($p > 0.05$) between group B and group C.

Table 5 Comparisons of physical characteristics between three different broiler groups

Effect	Group	Mean \pm SE	SD	Min	Max
Weight Day 24 (kg)	A	1.389 ± 0.016^b	0.082	1.260	1.565
	B	1.441 ± 0.013^a	0.067	1.340	1.580
	C	1.381 ± 0.015^b	0.077	1.225	1.510
Weight Day 39 (kg)	A	2.933 ± 0.028^a	0.144	2.690	3.340
	B	2.944 ± 0.025^a	0.129	2.715	3.130
	C	2.817 ± 0.039^b	0.203	2.440	3.090
Weight Gain Day 24 to Day 39 (kg)	A	1.544 ± 0.025^a	0.129	1.240	1.835
	B	1.503 ± 0.020	0.103	1.305	1.700
	C	1.436 ± 0.036^b	0.188	1.080	1.710
Shear Force Breast Meat (kg)	A	0.665 ± 0.017^x	0.088	0.499	0.854
	B	0.643 ± 0.030^x	0.156	0.397	0.947
	C	0.679 ± 0.018^x	0.093	0.522	0.868
Shear Force Drumstick Meat (kg)	A	0.825 ± 0.053^y	0.274	0.199	1.498
	B	0.910 ± 0.049^y	0.255	0.372	1.434
	C	0.801 ± 0.050^y	0.258	0.373	1.221

A: Yasinwater group; B: Broadcasting group; C: Control group

^{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 $p < 0.05$.

SE: Standard Error of the Mean

SD: Standard Deviation

Min: Minimum

Max: Maximum

From the Model Summary in Table 6, the R-square value for group A is 73.7%, 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 A is 0.859, Group B is 0.927 and Group C is 0.827 indicates a strong positive linear relationship between Weight Gain from Day 24 to Day 39 and Weight Day 39.

Table 6 Model Summary for Group A, B and C

Group	R	R Square	Adjusted R Square	Std. Error of the Estimate
A	0.859	0.737	0.727	0.067225
B	0.927	0.859	0.853	0.077983
C	0.827	0.683	0.671	0.082725

Figure 1, Figure 2 and Figure 3 show the linear regression plot of Weight Day 39 against Weight Gain from Day 24 to Day 39 for Group A, B and C. From the plot, Group B shows high correlation coefficients with the highest value of R-squared which is 0.853 followed by Group A with 0.737, and lastly Group C with 0.683.

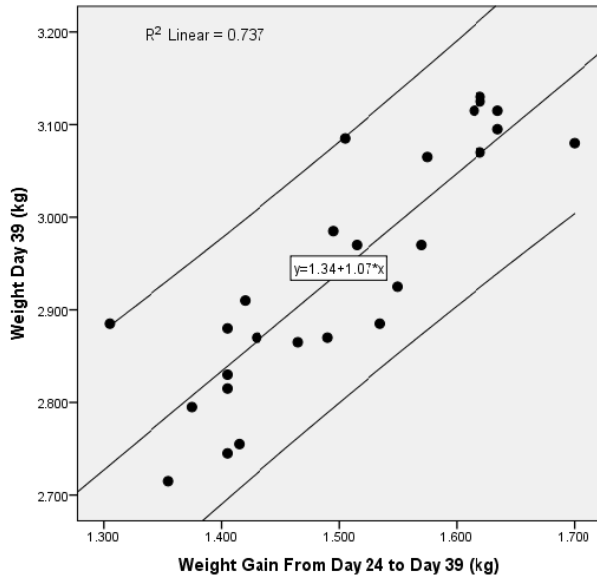


Figure 1 Linear regression plot Weight Day 39 versus Weight Gain from Day 24 to Day 39 for Group A

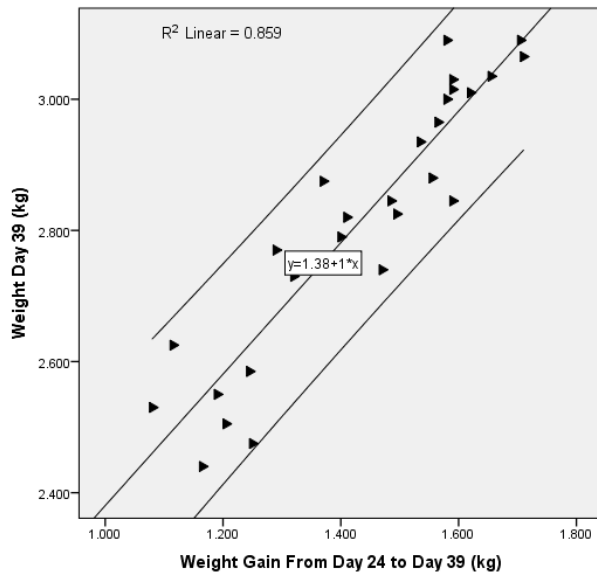


Figure 2 Linear regression plot Weight Day 39 versus Weight Gain from Day 24 to Day 39 for Group B

From the Coefficients table in Table 7, 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).

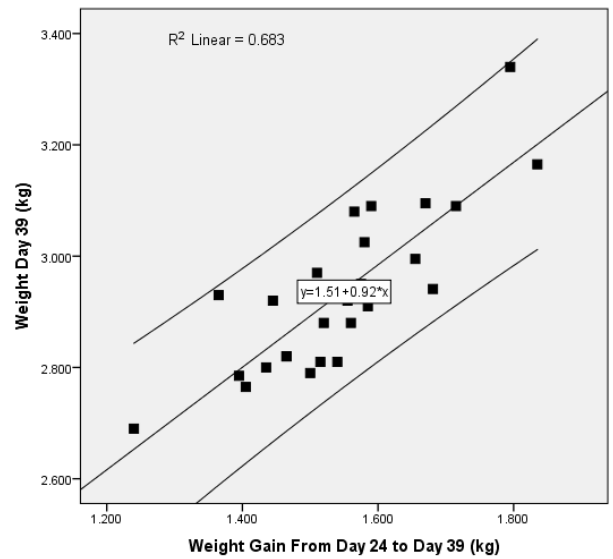


Figure 3 Linear regression plot Weight Day 39 versus Weight Gain from Day 24 to Day 39 for Group C

The estimated least-squares lines for all groups are as below:

Group A: $\hat{y} = 1.34 + 1.067x$ (1)

Group B: $\hat{y} = 1.378 + 1.0x$ (2)

Group C: $\hat{y} = 1.511 + 0.921x$ (3)

Table 7 Coefficients for Group A, B and C

		Coefficients ^a						
Group		U.C		S.C	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
A	(Constant)	1.340	.192		6.979	0.0	.944	1.735
	Weight Gain From Day 24 to Day 39 (kg)	1.067	.127	.859	8.375	0.0	.805	1.330
B	(Constant)	1.378	.118		11.700	0.0	1.135	1.620
	Weight Gain From Day 24 to Day 39 (kg)	1.002	.081	.927	12.322	0.0	.835	1.170
C	(Constant)	1.511	.194		7.779	0.0	1.111	1.911
	Weight Gain From Day 24 to Day 39 (kg)	.921	.125	.827	7.345	0.0	.663	1.179

^aDependent Variable: Weight Day 39 (kg)

U.C: Unstandardized Coefficients.

S.C: Standardized Coefficients.

4.0 DISCUSSION

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 calm the chicken from 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. The behaviour of the broilers of each group when dealing with the increase of temperature and heat at afternoon and evening were also had been monitored daily. The broilers in group B were more calm and less flapping of the wings compared to Group A and C that flapping the wings aggressively. Ladd *et al.* (1992) 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 [24].

Additionally, Gvarhayu *et al.* (1989) 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) [4, 5]. 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.

On the contrary, group A shows a significant effect on the chicken live weight measured on Day 39 and chicken weight gain from Day 24 to day 39 when compared to group C. Research done by Masaru Emoto proved how water can be affected by the vibration of words. Water when exposed to good words produced balanced and well-formed crystals but bad words produced crystals that were deformed and broken [8]. All the classical music that were exposed to the water resulted in well-formed crystals with distinct characteristics. In contrast, the water exposed to violent heavy-metal music resulted in uneven and distorted crystals at best [7]. Besides that, Masaru Emoto played to the water a tape of the Quran and it produced well-formed and symbolic designs of the Quran [9]. Exposing Surah Yasin to the water will enrich the water's quality to help and improve the broiler's health.

Although there was no significant difference ($p > 0.05$) of shear force in the breast and drumstick meats between the three groups, the shear force of the breast meats of group A, 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 [25]. The shear force

for breast meat is lower than red meat because white meat has less myoglobin (an oxygen-carrying protein) [26] compared to the 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 [26]. 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.

The death rate of the chickens in the entire coop for groups A and B were less than that of group C. Both experimented groups A and B 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 chickens had less risk of dying compared to the control chickens.

5.0 CONCLUSION

Findings from this research indicate that the exposure of the sound of Quran verses and adding Yasin water to the drink tanks produced better broilers compared to the control broilers. 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 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 and adding the Yasin water to the broilers' drink can be applied to improve the growth rate of farmed broilers, thus increasing the profit of the farmers.

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