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MEAT QUALITY IMPROVEMENT AND HERITABILITY OF BODY WEIGHT AND CHEMICAL COMPOSITION OF BREAST MEAT IN JAPANESE QUAIL *(Cotunix coturnix japonica)*

[1]Kaye J.*, [2]Akpa G.N., [3]Adeyinka I.A. and [4]Nwagu B.I.

[1]Department of Animal Production, University of Jos
[2]Department of Animal Science, Ahmadu Bello University, Zaria
[3]National Animal Production Research Institute, Ahmadu Bello University, Shika- Zaria
*Corresponding Author's E- mail: jokaye2003@gmail.com

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ABSTRACT

The study was conducted to investigate the effect of sex, age, generation on meat quality of 752 Japanese quail. Determined also were realized h^2 of body weight, body length and chemical compositions of the birds. Data obtained were subjected to analyses of variance and realized heritability calculated as appropriate for the following: To quantify changes in breast meat quality with respect to age and sex, body measurements with respect to sex, age and generations selected and to determine the realized h^2 of body dimension, body weight and chemical composition in Japanese quail. The result shows that the sex of birds were affected by pH20mins, pH24hr Cooking loss, colour(P and pectoral major water holding capacity and lightness colour (P The advanced in age significantly affects the pH20mins, pectoral major water holding capacity, cooking loss breast muscles, lightness, redness, yellowness, chroma, hue and driploss, pectoral major water absorbing capacity
Age, sex and generation significantly affect body length and some economic traits and sex of the birds except pelvic circumference and breast length in sex of Japanese quail. The realized h^2 for body weight at day 56, breast length and body length at day 35 ranges from moderate to high (0.24 – 0.71). The realized h^2 for chemical composition of the Japanese quail are low NFE (0.01), ash (0.04). The possibility depends on the genetic variability of body weight and body composition. The low, moderate to high realized h^2 is an indication that the traits are affected by additive genetic effects in the case of low h^2 and also for moderate to high h^2 the traits are affected by non additive genetic effects and environmental factors.

Key words: *Japanese quail, meat quality, body measurement, generations, realized h^2*

INTRODUCTION

The major poultry meat quality attributes are appearance, texture, juiciness, flavour and functionally. With increasing trends in further processing, meat functionality has increased in relative importance, especially because of its key role in determining the sensory quality of complex ready – to- eat products (Fletcher, 2002).Meat pH is one of the major contributing factors to poultry meat colour. Variation in pH significantly affected the storage and processing quality of poultry meat by modifying its water holding capacity and properties. Low pH meat is characterized by low water-holding capacity and poor quality and is usually referred to as pale, soft and exudative (PSE) meat (Barbut, 1997). High pH meat, known as dry, firm and dark (DFD), presents poor storage quality due to faster rate of off- odor production and accelerated microbial growth (Allen *et al.*, 1997).

Selection of meat – type quails focused not only on increased growth performance but also on improved carcass quality of the Japanese quail meat. In particular, the emphasis has been on better body composition, with higher breast meat yield and lower abdominal fat. This focus responds to the consumer desire for healthier meat, and to the evolution of the meat through a rising demand for portioned and processed products (Barton, 1994; LeBival-Duval, *et al.*, 1999). The profitability of quail production is therefore largely determined by the possibility of increasing the proportion of prime parts in the carcass determined, genetically (Debut, *et al.*, 2003).

Galobart and Moran (2004) and Musa *et al.* (2006) stated that there was rapid decrease in pH at early postmortem when carcass temperatures are still elevated as a result of pale, soft and exudative – like meat. Other similar investigation on meat quality was conducted (Pikul *et al.*, 1987; Knust and Pingel, 1992 and Witkiewicz, 2000).

Akram *et al.* (2013) stated that as quail advances in age body length, drumstick length and shank length increases. Nsosoet al. (2008) stated the body length and shank length to increase significantly up to 45 days of age. The analysis of body dimensions in poultry bird at different ages showed that their body length, drumstick length, shank length, breast length increases with advance in age (Kozaczyriski, 1999).

Body composition can be significantly improved by selection, as shown by the high level of the heritability of the amount of meat, ranging from 0.40 and 0.65 in the studies of Vereijken (1992), Jego *et al.* (1995), and Le Bihan- Duval *et al.* (1998). Many researches on selection to improved quail meat has been successful, but the impact on meat quality, and especially on storage and processing quality, remains to be clarified. Therefore, the research was geared towards determining meat quality improvement and heritability of body weight and chemical composition of breast meat in Japanese quail. The effect of sex, age and generation on meat quality in Japanese quail was the focus of this study.

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Poultry Unit of Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Samaru –Zaria. Zaria is within Northern Guinea Savannah zone of Nigeria, latitude 11' 12°N and longitude 7' 33°E at an altitude of 610M above sea level. The climate is relatively dry, with mean annual rainfall of 700-1400mm, occurring between the Month of April and September. The dry season begins around the middle of October, with dry cold weather that ends in February. This is followed by relative hot, dry weather from March to April, when the rain begins. The mean minimum and maximum daily temperature is about 14° and 24°C during the cool season and 19° and 36°C during the hot season. The relative humidity varies between 19% in the dry season and between 63% and 80% in the wet season as stated by Akpa *et al.*(2002).

Mating Plan

Artificial selection was carried out on the birds at day 35, 42, 49 and 56 after weighing all the birds. Those with the highest weight were chosen for breeding consisting of 28 males and 84 females. The selected birds were mated in a constructed cage at the ratio of 1 male to 3 females (1:3) in constructed caged of 10cm x 10cm x 10cm to determine the BW, carcass weight, Body Length traits, minerals and chemical composition of meat. For the study that utilized mating ratio 1:3, all the birds were wing banded in accordance with the families and 1500 fertile eggs were hatched.

Management of Fertile Egg

Eggs were collected daily after the birds had reached maturity. Eggs were identified by their sire families (28), stored at room temperature lower than 20°C and 65% relative humidity (RH) for a week, and then disinfected with tetra hydroxyl (TH4) mixed with 1 liter of water for spraying on egg surface. Pedigreed eggs were set in the setting trays, depending on their sire families and arranged in a forced draft incubator with temperature of 37.5°C and 65% RH. Eggs were turned automatically every three hours. At the end of the 14th day of incubation, eggs were transferred into pedigree hatching baskets and moved into the hatcher where the temperature was 37.5°C and RH was 70%.

Incubation and Hatching of Fertile Eggs

Pre-incubation of the fertile egg collected was made by storing them at a temperature of 15°C. Fumigation was done 12 hours before placing them in the incubator. When eggs were set in the incubator, temperature requirement was put at 37.5 °C with humidity of 60% and turning of eggs was at an angle of 45° for 4-6 times a day and the chicks were hatched at day 18 of incubation.

Experimental Birds and their Management

The research Japanese quails were purchased at 21 days of age, from National Veterinary Research Institute (NVRI), Vom, Plateau State. The management of the young chicks included the provision of supplementary heat for 4 weeks at least 24 hours lighting, and thereafter 13 to 16 hours light and 6 to 8 hours dark cycle. Indoor air temperature for the chicks was 36 °C. Birds were allowed ad libitum access to food and water. They were fed with starter and grower diet containing 24% crude protein (CP) and 2904ME, Kcals / kg between 1-35 days of age. Thereafter a breeder diet containing 23% CP and 2800, Kcals / kg ME was fed. The same diets were provided to birds on the selection process across various generations. The minerals and vitamins were adequately supply to cover the requirements according to NRC (1994).

Data collection

Three generations namely base population, G_1 and G_2. The following data were collected on each generation:

Body length

Six hundred and seventy-two birds were used to study the body length (cm) traits of the birds. The birds were sexed at day 21 at which point they were feathered.

Live Body Length Measurement (cm)

The same six hundred and seventy two birds used for live body weight measurement and live body length traits measurement were taken on the birds. The measurements were taken after sexing at day 21 (point when birds were feathered).

Pelvis circumference (cm): measured by using vernier caliper across the pelvis, Breast Length (cm): Obtained by using a tailors tape, measured from the back bone to the last cervical vertebra round the body, Shank Length (cm): Obtained by using a tailors tape from the hock joint to the base of the 3 toes, Drumstick +Thigh length (cm): Determined by using the tailors tape from the pelvis joint down through the thigh drumstick to the hock joint before shank, Wing length (cm): Determined by placing tailors tape across from the tip to the point of attachment of wing to the body of the bird Breast circumference (cm): Vernier caliper was used to determine the circumfrence of the breast, corrected to the nearest 0.01mm.

Quail Meat Proximate Composition:

Three samples from the birds slaughtered for body weight measurement were taken from female and male birds collected from breast portion weekly at day 35, 42, 49, 56 for G_0, G_1, G_2 to determine moisture, protein, fat, ash, and NFE contents. They were determined in accordance with the standards of AOAC methods (AOAC, 2000). Protein determination involved a Kjeldahl assay (N x 6.25). Fat was determined by extracting samples in a soxhlet apparatus using petroleum ether as a solvent. Moisture was quantified by oven-drying 10g samples at $100^{\circ}C$ over night. Ash was determined after incineration in a furnace at $550^{\circ}C$ and carbohydrate content was calculated by computing the difference.

Rate and the Intensity of the Muscle Acidification during Post mortem:

Physical and chemical traits from the left side of the breast sample was taken from the 10 male and 10 female birds at day 35, 42, 49 and 56 to determine breast muscle pH_{20min} (pH_{20min})post slaughter and pH_{24hour} (pH_{24hr}) post slaughter. At the 24th *post mortem* hour, hydrophilic properties of meat were also determined as – water holding capacity (WHC) and water absorption capacity (WAC) and colour characteristics of the meat were determined:

The breast muscles pH was determined with ten female and ten male birds were slaughtered at day 35, 42, 49 and 56 after a 6-hour fasting period. After slaughter, evisceration and defeathering, pH_{20min} and pH_{24hr} values were measured with a pH meter, equipped with glass electrode and a temperature probe. The pH of a solution was taken the negative logarithm of the hydrogen ion activity determined in breast portion of meat using standard buffer solutions. They were prepared with carbon-dioxide-free water and stored in bottles of chemically resistant glass. The apparatus was calibrated with standard buffer solutions to check the linearity of the response of the electrode at different pH values and to detect a faulty glass electrode. The standardization of the apparatus was calibrated with two standard buffer solutions. After the apparatus has been calibrated, the electrodes and the cups were thoroughly washed. The cup were fill with a portion of the solution tested and preliminary values were obtain before getting the actual value of the pH subsequently for each sample of day 35,42,49 and 56 for the two sexes.

Water Holding Capacity (WHC) was determined with ten samples of approximate size of 2.0x1.0x0.5 cm meat were obtained from the pectoral muscles. They were weighed with a precision of 0.001 g, and put in tubes containing 15 ml saline. Samples were left for 24 hours at about 2-4^{0C}. After 24 h, meat pieces were removed from the tubes, carefully dried on a filter paper and again weighed on the same scales.

The WHC of meat was calculated as:

$$WHC = (b-a) \times \frac{10}{a}$$

Where: a – weight of the piece of meat prior to analysis (g), b - weight of the piece of meat after a 24-stay in physiological saline (g).

The Water Absorbing Capacity (WAC) of meat was determined in saline. Two samples of approximate size of 2.0x1.0x0.5 cm meat were obtained from the pectoral muscles. They were weighed with a precision of 0.001 g, and put in tubes containing 15 ml saline. Samples were left for 24 h at about 2-40^C. After 24 h, meat pieces were removed from the tubes, carefully dried on a filter paper and again weighed on the same scales.

The WAC of meat was calculated as:

$$WAC = (b - a) \times 10 / a \quad (b\text{-}a) \times \frac{10}{a}$$

Where: a – weight of the piece of meat prior to analysis, g; b - weight of the piece of meat after a 24hr - stay in physiological saline, g.

The muscles colour was determined by taken a sample of sliced meat from the posterior part of the breast muscle was obtained from 10 female and 10 male Japanese quail after slaughter to determine the colour of muscles set-up a spectrophotometer produced by X-Rite incorporated. The values of L*, a* and b* colorimetric coordinates were determined on scale (Riegel *et al.*,2003): L^*= corresponds to Lightness,a^*= corresponds to Redness,b^*= corresponds to yellowness,On the basis of a* and b* values were calculated as follows:

Chroma (C) = (a*^2+b*^2)^0.5

Hue angle (h^o), that specifies the site of cross point of coordinates a* and b*: h^o=tg1 (b* / a*)

Estimation of Genetic Parameters

Realized heritability

The realized heritability (*h2*) for traits were obtained for each generation by the formula (*h2* = R / S) that is the ratio of selection response to total selection differential. The response to selection (R) was determined as the deviation of the selected progeny mean from the mean of the parent generation (Falconer, 1970). The selection differential (S) was estimated as the difference between the mean of the selected population and the overall population. Significant differences among means were separated by the Duncan's multiple range test (Duncan, 1955).

Statistical analysis

Statistical analysis was done by the aid of SAS software (SAS, 2004) according to the following Statistical models:

$$Y_{ijkl} = \mu + G_i + H_j + s_k + GH_{ij} + GS_{ik} + e_{ijkl}$$

Where: Y_{ijkl}= the observation of ijklth bird, μ = overall mean, G_i = effect of ith generation (I = 0, 1, 2), H_j= effect of jth age (j = 35, 42, 49, 56 day), s_k= effect of kthsex (k = male and female),e_{ijkl}= random error. Significant differences between means were ranked by using Duncan's Multiple Range Test (Duncan,1955).

RESULTS AND DISCUSSION

Table 1 shows the least square means of breast meat quality of Japanese quail as influenced by age and sex. The result for the breast meat differed significantly (P<0.05) in age and sex, except pectoralis major water holding capacity, lightness (L*) which differed significantly (P<0.01) in sex and % drip loss, pectoral major water absorbing capacity which are not significant also in sex. The % driploss and pectoralis major water absorbing capacity differed significantly (P<0.01) for age of Japanese quail.

The sex of the birds that shows that female traits improved more than the males in P^H20 mins, pectoralis major water absorbing capacity, lightness(L*), yellowness(b*). While males are more than females in P^H_{24min} , cooking loss breast muscle, Redness, chroma. As birds advances in age there was decline in P^H_{20mins} , pectoral major water holding capacity, lightness (L*), Chroma, Hue. The P^H_{24mins}, % droploss, Pectoral major, water absorbing capacity, Lightness(L*), Redness(a*) yellowness(b*) shows intermittent increased and decreased.

The least square means for body length and some economic traits affects the sex and generations of Japanese quail at day 56 is shown in Table 2. The result indicated that body length and body weight differed significantly (P< 0.05) in sex and generation of birds, except body weight 56 which differed significantly (P< 0.01) in sex, while non significant difference was observed for pelvic and breast circumference. The females have higher body length and body weigth increase than the males except body length at day 35. There was improvement in generation selected (Gs) than G1 and G_2, but G_2 has higher value increase than G_1.

The realized heritability of body dimension at day 35, 42, 49 56; body weight at day 56 and various body parts dimension at day 56 of Japanese quail is shown in table 4. The result indicated that realized h2 for the traits are from moderate to high. The responses to selection in mean and percentage values for response to selection are lower than selection differential.

Table 5 show the realized heritability of chemical composition of Japanese quail and the result indicated that h2 values were low for ash and nitrogen free extract while crude protein, oil were moderate and dry matter was high. The response to selection mean and percentages were lower than the selection differential.

Table 1: Least square means of breast meat quality of Japanese quail as influenced by age and sex

Characteristics	N	Sex		LoS	Slaughter age (d)				LoS
		Males	Females		D_{35}	D_{42}	D_{49}	D_{56}	
pH_{20mins}	10	6.1 ± 0.22^{a}	6.3 ± 0.15^{a}	*	6.5 ± 0.18^{a}	6.5 ± 0.20^{a}	6.05 ± 0.19^{b}	6.0 ± 0.12^{b}	*
$pH_{24hours}$	10	5.9 ± 0.11^{a}	5.8 ± 0.01^{a}	*	5.9 ± 0.03^{a}	5.8 ± 0.02^{a}	5.8 ± 0.01^{b}	5.3 ± 0.05^{b}	*
% Drip loss	10	0.8 ± 0.01^{a}	0.8 ± 0.04^{a}	Ns	4.0 ± 0.02^{d}	0.8 ± 0.02^{a}	0.7 ± 0.03^{b}	$0.6\pm0.0.05^{c}$	**
pectoralismajor,water holding capacity	10	17.7 ± 0.62^{b}	20.3 ± 0.41^{a}	**	17.9 ± 0.41^{c}	18.7 ± 0.43^{b}	19.7 ± 0.45^{a}	$19.8\pm0.0.46^{a}$	*
Pectoralis major, water absorbing capacity	10	23.4 ± 0.62^{a}	23.4 ± 1.75^{a}	Ns	27.2 ± 1.75^{a}	23.7 ± 1.91^{b}	22.8 ± 1.11^{b}	19.9 ± 1.89^{c}	**
Cooking loss, breast muscle	10	31.1 ± 2.47^{a}	27.3 ± 0.85^{b}	*	25.4 ± 0.85^{d}	26.6 ± 1.56^{b}	30.1 ± 1.56^{c}	34.9 ± 0.78^{a}	*
Lightness(^{L})	10	42.9 ± 0.52^{c}	44.4 ± 0.83^{a}	**	44.8 ± 0.93^{a}	43.7 ± 0.85^{b}	43.5 ± 0.03^{b}	42.7 ± 0.56^{d}	*
Redness(^{a})	10	10.8 ± 0.41^{a}	10.7 ± 0.40^{a}	*	10.1 ± 0.41^{a}	10.4 ± 0.40^{a}	11.0 ± 0.48^{b}	11.4 ± 0.25^{b}	*
Yellowness(^{b})	10	11.0 ± 0.20^{a}	11.4 ± 0.32^{a}	*	11.1 ± 0.32^{a}	11.3 ± 0.36^{a}	11.1 ± 0.31^{a}	11.3 ± 0.61^{a}	*
Chroma(C^{o})	10	15.2 ± 0.46^{a}	14.9 ± 0.36^{b}	*	14.4 ± 0.17^{d}	15.5 ± 0.57^{b}	15.5 ± 0.42^{c}	15.7 ± 0.46^{a}	*
Hue(h^{o})	10	0.7 ± 0.17^{a}	0.7 ± 0.59^{a}	Ns	0.6 ± 0.06^{c}	0.7 ± 0.05^{b}	0.8 ± 0.02^{a}	0.8 ± 0.03^{a}	*

Means for each character within sex generations and age with different superscripts differ*= ($P< 0.05$),**=($P< 0.01$); G_0= Base population; G_1=Generation one, G_2=Generation two, $p^{H}20min$ = p^{H} value after 20min postmortem; $p^{H}24hr$ = p^{H} value after 24hr postmortem

Table 2: Least square means for some parts of body dimension in Japanese quail of different generations and sex

Traits		Sex			Generation			
		Males	Females		G_0	G_1	G_2	
	N	M±SE	M±SE	LoS	M±SE	M±SE	M±SE	LoS
Body length35(cm)	56	14.1 ± 0.37^a	14.0 ± 0.67^b	*	15.1 ± 0.32^a	13.7 ± 0.53^c	14.2 ± 0.81^a	*
Body length42(cm)	56	9.1 ± 0.32^b	9.6 ± 0.27^a	*	9.9 ± 0.42^a	9.5 ± 0.45^c	9.7 ± 0.24^a	*
Body length49(cm)	56	10.6 ± 0.34^b	10.9 ± 0.26^a	*	10.1 ± 0.31^b	10.2 ± 0.42^c	10.8 ± 0.22^a	*
Body length56(cm)	56	10.2 ± 0.21^b	12.7 ± 0.16^a	*	13.9 ± 0.16^b	10.7 ± 0.54^b	11.6 ± 0.32^a	*
Body Weight 56(g)	56	207.3 ± 2.76^b	235.8 ± 2.3^a	**	244.5 ± 2.12^b	228.1 ± 2.94^c	232.1 ± 2.52^a	*
DAY 56:								
Pelvic circumf (cm	56	3.2 ± 0.08^a	3.2 ± 0.07^a	Ns	3.5 ± 0.82^b	2.8 ± 0.28^c	3.2 ± 0.08^a	*
Breast Length (cm)	56	7.2 ± 0.29^a	7.2 ± 0.28^b	*	7.9 ± 0.31^b	7.2 ± 0.18^b	7.6 ± 0.23^a	*
Shank Length (cm)	56	3.1 ± 0.14^a	3.2 ± 0.30^b	*	3.4 ± 0.07^b	2.9 ± 0.08^c	3.1 ± 0.08^a	*
Drumstick Length (cm)	56	$5..3\pm0.14^a$	5.6 ± 0.15^a	*	5.8 ± 0.12^b	4.1 ± 0.22^c	4.6 ± 0.14^a	*
Wing Length (cm)	56	8.6 ± 0.03^a	8.3 ± 0.02^b	*	8.7 ± 0.06^b	8.2 ± 0.04^b	8.4 ± 0.07^a	*
Breast circumf (mm	56	3.1 ± 0.05^a	3.1 ± 0.02^a	Ns	3.9 ± 0.01^b	3.1 ± 0.22^c	3.3 ± 0.02^a	*

Means within each row for the sexes and generations columns with different superscripts differ*= ($P < 0.05$),**=($P < 0.01$); NS = not significant, LS= Level of significance, G_0 = Base population; G_1= Generation one; G_2 = Generation two.

Table 3: Realized heritability of body dimension of Japanese quail

Traits	Response to Selection		Selection Differential		Realized h^2
	Mean	%	Mean	%	
Body length35(cm)	0.5	3.52	1.4	9.27	0.36
Body length42(cm)	1.0	6.45	1.4	3.77	0.71
Body length49(cm)	0.6	4.05	0.9	5.96	0.67
Body length56(cm)	0.4	2.56	0.7	4.40	0.57
Body Weight56(g)	4.0	1.72	16.4	6.71	0.24
DAY 56:					
Pelvic circumference (cm)	0.4	20.00	0.7	20.00	0.57
Breast Length (cm)	0.4	5.26	0.7	8.86	0.57
Shank Length (cm)	0.2	20.00	0.5	14.71	0.40
Thigh Length (cm)	0.5	13.89	0.7	18.42	0.71
Wing Length (cm)	0.2	2.38	0.5	5.75	0.40
Breast circumference (mm)	0.2	6.06	0.8	20.51	0.25

Table 4: Realized heritability of chemical composition of Japanese quail

Traits	Response to Selection		Selection Differential		Realized h^2
	Mean	%	Mean	%	
Dry matter	7.55	8.43	9.14	10.02	0.83
Crude protein	4.21	16.10	15.68	41.68	0.27
Oil	3.93	12.52	11.93	30.29	0.33
Ash	1.29	17.00	2.74	30.31	0.04
Nitrogen free extract	0.06	0.14	9.65	18.39	0.01

The breast meat quality was influenced by age and sex of Japanese quailsignificantly as shown in table 2. The sex of birds were affected by pH_{20mins}, pH_{24hrs} cooking loss, breast muscle, Redness, Yellowness and Chroma colour ($P<0.05$) and pectoral major water holding capacity and lightness colour ($P<0.01$) The rapid decrease in pH early postmortem when carcass temperatures are still elevated as a result of pale, soft and exudative – like meat. This is similar to study of Galobart and Moran (2004) and Musa *et al.* (2006). The possibility of genetically improving carcass quality by selection depends on the genetic variability of body weight and body composition.

The advanced in age significantly affects the pH_{20min}, pectoral major water holding capacity, cooking loss breast muscles, lightness, redness, yellowness, chroma, hue ($P<0.05$) and of drip loss, pectoral major water absorbing capacity ($P<0.01$). As birds advances in age, water holding capacity, pH, drip loss, pectoral major water holding capacity, pectoral major water absorbing capacity, cooking loss, colour as usually determine in breast muscle are very important culinary value and technological properties of the quail meat. Other similar investigation on quality is conducted (Pikul *et al.*, 1987; Knust and Pingel, 1992; Witkiewicz, 2000).

Age, sex and generation significantly affect body length and some economic traits and sex of the birds except pelvic circumference and breast length in sex of Japanese quail as shown in table 2. Similar findings were reported by Akram *et al.* (2013) that as the birds advance in age body length, drumstick length and shank length increases. Nsoso *et al.* (2008) further strengthened the body length and shank length increased significantly up to 45days of age. The analysis of body dimensions in poultry bird at different ages showed that their body length, drumstick length, shank length, breast length increases with advance in age (Kozaczyriski, 1999). The increased in the body length, pelvic circumference, breast length, shank length, drum stick + thigh length, wing length and breast length might be considered normal because age is a major determinant of growth and physiological development (Sonaiya *et al.*, 1986 and Ojedapo *et al.*, 2012).

The realized heritability of body length at day 35, 42, 49, 56 body weight at 56, body parts dimensions at day 56 were shown in table 3. The realized h^2 for body weight at day 56, breast length and body length at day 35 were moderate 0.24, 0.25, 0.36,respectively.While the remaining traits shows high realized h^2 (0.40 – 0.71). There is dearth information on h^2 of body weight at day 45 was reported by Caron h^2. (1990) while h^2 values were reported by Ahuja *et al.* (1983); Sato *et al.* (1986); El-fiky (1991); Sharaf (1992) and Solima (1992). The moderate to high h2 observed in this study indicated that traits were affected by non additive genetic effect and environmental factors; therefore the remedy to the situation is by continuous selection. The realized h^2 of chemical composition of Japanese quail in table 5 indicated that nitrogen free extract (0.01), ash (0.04) are low in h^2,that indicates that they are affects while crude protein (0.27) and oil (0.33) h^2 are moderate and dry matter h^2 are high, due to non genetic effect and environmental factors. Therefore continuous selection should be done to achieve better result. There are dearth researches on the h2 on chemical composition of Japanese quail.

CONCLUSION

Japanese quail sex is affected by $P^H{}_{20mins,}P^H$24hr Cooking loss, pectoral major water holding capacity and lightness colour. The advanced in age affects the P^H20mins, pectoral mojor water holding capacity, cooking loss breast muscles, lightness, redness, yellowness, chroma, hue, driploss and pectoral major water absorbing capacity. Age, sex and generation significantly affect body length, economic traits and sex of the birds. The realized h2 for body weight at day 56, breast length and body length at day 35 ranges from moderate to high (0.24 – 0.71). The realized h2 for chemical composition of the Japanese quail are low NFE (0.01), ash (0.04). The moderate to high heritability indicates that response to selection for high body weight cold be rapid therefore selection for high body weight can be achieved for body weight at day 56, breast length and body length at day 35 can while low h2 shows that response was a slow process therefore selection to improve on the traits may occur gradual because of additive genetic effects.

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