The productivity of 4th Generation KUB-2 Chicken

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ABSTRAK

Sartika T, Iskandar S. 2019. Produktivitas ayam petelur KUB-2 generasi ke-4. JITV 24(4): 151-157. DOI: http://dx.doi.org/10.14334/jitv.v24i4.2033

Ayam KUB-2 adalah ayam hasil seleksi dari KUB-1 untuk produksi telur dan warna *shank* kuning. Ayam KUB-1 sebanyak 64% mempunyai warna bulu dengan warna dasar hitam. Warna bulu hitam berpengaruh terhadap warna kulit karkas yang agak gelap, sehingga kurang disukai konsumen. Warna *shank* kuning mempunyai korelasi positif dengan warna kulit karkas yang cerah berwarna kuning. Dalam penelitian ini digunakan sebanyak 517 ekor ayam dara KUB-2 hasil seleksi generasi ke-4 yang terdiri atas 194 ekor KUB-2$_{kk}$ (kaki kuning) dan 323 ekor KUB-2$_{nk}$(non kuning). Semua ayam ditempatkan pada kandang individu dan dievaluasi selama 6 bulan pertama masa produksi telur. Peubah yang diamati adalah umur pertama bertelur (UPB), bobot induk pertama bertelur (BIPB), bobot telur pertama (BTP), rataan bobot telur (RBT), produksi telur (PT) selama 6 bulan pertama (24 minggu), mortalitas, konsumsi dan konversi pakan. Hasil penelitian menunjukkan bahwa UPB, BIPB, BTP dan PT ayam KUB-2$_{kk}$ dan KUB-2$_{nk}$ generasi ke-4 tidak berbeda nyata (P>0,05). Pada KUB-2$_{kk}$ dan KUB-2$_{nk}$ menunjukkan masing-masing untuk UPB: 156,2 hari dan 158,1 hari; BIPB: 1788 g dan 1808 g, dan BTP: 31,32 g dan 31,34 g. PT selama 24 minggu masing-masing untuk KUB-2$_{kk}$ dan KUB-2$_{nk}$ generasi ke-4 adalah 103,3 butir atau 61,5% dan 101,9 butir atau 60,7%, dan FCR 25-43 minggu masing-masing untuk KUB-2$_{kk}$ dan KUB-2$_{nk}$ generasi ke-4 adalah 3,53 dan 3,54. Rataan bobot telur meningkat seiring meningkatnya umur ayam, mortalitas untuk seluruh populasi hanya 0,98%.

Kata Kunci: Ayam KUB-2 Generasi Ke-4, Produksi Telur, Kaki Kuning

ABSTRACT

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KUB-2 line of chicken has improved local chicken selected from the KUB-1 chicken line. KUB-2 was selected for more egg production and yellow shank. KUB-1 chicken has 64% various of black feather color, which sometimes tends to have unpreferred dark carcass. Yellow shank color has a positive correlation with the skin color of carcass. As many as 517 pullets of KUB-2 at 4th generation were divided into two groups of 194 pullets of KUB-2$_{kk}$ (yellow shank) and 323 pullets of KUB-2$_{nk}$ non-yellow shank). The chickens were raised intensively in the individual cages for the 24 weeks observation. Variables measured were age at first egg (AFE) bodyweight at first egg (BWFE), egg weight at first egg (EWFE), average egg weight (AEW), average egg production (AEP) during 24 weeks, feed conversion ratio (FCR) of 25-43 weeks of age, and mortality. The result showed that there was no statistically significant different (p>0.05) between KUB-2$_{nk}$ and KUB-2$_{kk}$ respectively for AFE of 156.2 d and 158.1 d, for BWFE of 1788 g and 1808 g, for EWFE of 31.32 g and 31.34 g, for AEP$_{24}$ of 103.3 eggs or 61.5% and 101.9 eggs or 60.7%, and for FCR$_{25-43}$ of 3.53 and 3.54. AEW increased with increasing age of hen, the mortality of the whole population was 0.98%.

Key Words: 4th Generation KUB-2 Chicken, Egg Production, Yellow Shank

INTRODUCTION

KUB-2 line of chicken has been selected from its ancestor of the KUB-1 line. The KUB-1 is a moderate egg type of local chicken invented by the Indonesian Research Institute for Animal Production (IRIAP) and was released for the commercial by the Agricultural Minister No. 274/Kpts/SR.120/2/2014 (Direktorat Jenderal Peternakan dan Kesehatan Hewan 2014). The production of KUB-1 has been licensed to a few national medium and small local chicken breeders since early 2017 (IRIAP, 2018 Pers Com). The KUB-1 produces egg up to 50% henday production (HDP) or about 180 eggs/hen/year. Sartika et al. (2013) recognized the feather color of the population of KUB-1 was 64% dark-color base with shank color of about 74% dark. Shank color has a positive correlation with carcass skin and beak color (Gao et al. 2017). Chinese local chickens, Xianju and Baler Yellow chickens have yellow shank, beak, with feather color of red-yellow

buff is selected for egg type chicken line and China Chongren Patridge and Dongxiang Blue which have black and grey shank colors, usually have white or grey skin, beak with feather color of black-greyish and reddish in male and black spotted in female, is bred for egg and meat (Gao et al. 2017). In fact, Indonesia has chicken breeds that have yellow shank and skin with a yellow-reddish buff feather with Columbian pattern. The breeds called Merawang and Nunukan, which were originally brought from China a hundred years ago (Sartika et al. 2016). Genetically the yellow shank is influenced by the beta-carotene dioxygenase 2 (BCDO2) gene, which is used as a genetic marker for identifying the gene that determines shank color (Eriksson et al. 2008; Gao et al. 2017). They furthermore reported that yellow shank color is generated from or belongs to the cluster of grey jungle fowl (*Gallus sonneratii*) whilst white/grey/black are generated from or belong to a cluster of red jungle fowl (*Gallus gallus*).

KUB-2 line was obtained by selecting KUB-1 as it was still a high variation in egg production. In another word, the KUB-2 line was not the product of crossbreeding the KUB-1 line with other local breeds. The improvement of the breed through selection is time-consuming which is resulting in more permanent product quality (Padhi 2016), whilst crossbreeding may increase productivity quickly, but it will deplete its original genetic resources very fast (Dessie et al. 2011). Some developing countries like Ethiopia (Mengesha 2012; Hailu et al. 2014; Gebremariam et al. 2017; Terfa et al. 2019), Kenya (Magothe et al. 2015; Kamau et al. 2019), Nigeria (Nwogwugwu et al. 2018), Ghana (Osei-Amponsah et al. 2015), India (Haunshi et al. 2019), and Thailand (Suphawadee & Tuan 2016), have increased their local breeds of chicken either through selection or crossbreeding. Eventually in Indonesia, the work of improvement of local chicken breeds has been initiated as well (Sartika et al. 2013; Iskandar & Sartika 2014).

The aim of the research was to explore the development of laying performance of the 4th generation of KUB-2$_{kk}$ (yellow shank) and KUB-2$_{nk}$ (non-yellow shank), selected for more egg. The aim was also to see whether the selection for yellow shank would influence laying performance of the 4th generation of KUB-2 line of chicken.

MATERIALS AND METHODS

The KUB-2 line was selected from the KUB-1 line for egg production and yellow shank. The 40% of the highest egg production of each generation of KUB-2 line was selected and generated KUB-2$_{kk}$ line of chicken having a yellow shank and KUB-2$_{nk}$ line of chicken having no yellow shank. Five hundred and seventeen of 4th generation KUB-2 pullets age of 16 weeks, were grouped into sublines of 194 KUB-2$_{kk}$ and 323 KUB-2$_{nk}$ pullets.

The pullets were confined in the individually wire-cage of 35 cm height x 40 cm width x 40 cm length. Feed composed of 75% commercial layer feed (17% protein, 2850 kcal ME/kg, 3.4% Ca, 5% fiber) mixed with 24% wheat pollard and 1% mineral premix (Sinurat et al. 2014, with modification changes rice bran to wheat pollard). The feed contained 16.1% crude protein, 2800 kcal ME/kg, 3.2% Ca, 0.5% total P, 0.9% lysine, 0,45% methionine, and 6.15% crude fiber, was daily served at the amount of 100 g/pullet. Drinking water was served ad libitum. Feed supplement egg stimulant was added to drinking water as much as 50 g per 100 liters water given in five days continuously, especially in the extreme climate, such as heavy rain or dry and moist environment. In addition, the husbandry of the experiment pullets was fulfilled animal welfare condition under the regulation of the Indonesian Agency for Agricultural Research and Development (IAARD) Animal Welfare Commission of IRIAP/A/01/2018.

Variables measured were an age at first egg (AFE), bodyweight at first egg (BWFE), egg weight at first egg (EWFE), average egg weight (AEW), average egg production of 20-43 weeks of age (AEP$_{24}$), feed conversion ratio (FCR) and mortality. The data were then analyzed by t-test using software Minitab version 14.

RESULTS AND DISCUSSION

Age at first egg (AFE), body weight at first egg (BWFE), and egg weight at first egg (EWFE)

Age at first egg (AFE), bodyweight at first egg (BWFE), and egg weight at first egg (EWFE) of KUB-2 chicken at 4th generation of selection are presented in Table 1. AFE of KUB-2$_{kk}$ (158.1 ± 26.2 days or 22.6 weeks) was not significantly (p>0.05) different from AFE of KUB-2$_{nk}$ (156.2 ± 21 days or 22.3 weeks). The average AFE of whole populations was 156.9 days or around 22.4 weeks, which was ideal as it was shorter compared to their parent of KUB-1 line, ranging from 166.9-183.1 days (23.8 – 26.2 weeks) (Sartika et al. 2013). Acceleration of AFE after eight generations of selection was also reported by (Haunshi et al. 2019) in local Aseel Indian chicken from 159.7 days (22.8 weeks) to 173.9 days (24.8 weeks). (Wondmeneh et al. 2016) reported that Ethiopian local Horro chicken responded AFE at 159.5 days (22.8 weeks) to seven generations of selection. They also fund out the quickest first lay was at 112 days (16 weeks) of age for few hens, which was increasing slowly up to 19 weeks of age. At the age of 140 days (20 weeks), there was only 10% of the population laid an egg, which was adopted as the first date of proper egg production recording.

Table 1. Age at first egg (AFE), bodyweight at first egg (BWFE), and egg weight at first egg (EWFE) of KUB-2 chicken at 4th generations of selection

	No (pullets)	Age at first egg (AFE)					
		Average (days)	St.deviation (days)	Min (days)	Maks (days)	t-value	P-value
KUB-2$_{kk}$[1]	194	158.1	26.2	112	245	0.90	0.367
KUB-2$_{nk}$	323	156.2	21.0	114	244		
		Bodyweight at first egg (BWFE)					
		(g)	(g)	(g)	(g)		
KUB-2$_{kk}$	194	1808	240	1220	2782	0.92	0.356
KUB-2$_{nk}$	323	1788	231	1178	2649		
		Egg weight at first egg (EWFE)					
		(g)	(g)	(g)	(g)		
KUB-2$_{kk}$	194	31.34	5.44	19	52	0.27	0.790
KUB-2$_{nk}$	323	31.32	4.67	17	51		

[1] kk = Yellow shank; nk = Non-yellow shank

Table 2. Egg weight of KUB-2 chicken at 4th generation of selection

Age at week		KUB-2$_{kk}$[1] (n=190)	KUB-2$_{nk}$ (n = 322)
18-20	Average (g)	30.01±2.41	29.99±2.10
	CV (%)	8.04	7.03
21-24	Average (g)	35.70±1.56	35.71±1.88
	CV (%)	4.36	5.27
25-28	Average (g)	39.10±1.05	39.16±1.06
	CV (%)	2.57	2.70
29-32	Average (g)	41.68±1.04	41.60±0.73
	CV (%)	2.49	1.75
33-36	Average (g)	43.50±0.88	43.69±0.56
	CV (%)	2.04	1.28
37-40	Average (g)	44.51±0.30	44.79 ± 0.75
	CV (%)	0.66	1.68
41-44	Average (g)	45.65±0.48	46.09±0.42
	CV (%)	1.04	0.92

[1] kk = Yellow shank; nk = Non-yellow shank

Table 3. Egg production of KUB-2 chicken at 4th generation during the first 24 weeks

	N (pullets)	Average		St.deviation		Minimum		Maksimum		Values	
		(eggs)	(%)	(eggs)	(%)	(eggs)	(%)	(eggs)	(%)	(t)	(P)
KUB-2$_{kk}$[1]	190	101.9	60.7	27.8	16.5	5	2.95	154	91.7	-0.57	0.57
KUB-2$_{nk}$	322	103.3	61.5	25.9	15.4	5	2.98	151	89.9		

[1] kk = Yellow shank; nk = Non-yellow shank

Assefa et al. (2018) reported that Ethiopian local chicken, which was raised in high altitudes had longer AFE than when it was raised in lower altitudes. They also reported that AFE had a negative correlation with egg production (p<0.01; R= -0.57), which meant the faster the AFE the lower egg production. Mengesha (2012) reported also on Ethiopian local chicken, which had AFE 157-161 days or about 22.7 weeks of age at intensive husbandry, while under semi-intensive, their AFE was longer (25 – 25.7 weeks). So Shumuye et al. (2018) reported on Koekoek Ethiopian local chicken which had AFE of 6 months when raised in the villages. Further Shumuye et al. (2018) added their information on Ethiopian indigenous, Sasso and Koekoek raised in high altitude showed their AFE of 252, 162 and 184 days with egg production of 53.7, 137 and 148 eggs/hen/year, respectively. When those breeds were raised in low altitude their AFE was quicker (224, 147 and 148 days), but egg production was also lower (44.6, 129 and 115 eggs/hen/year respectively for Ethiopian indigenous, Sasso and Koekoek).

Bodyweight of the hen at the first egg laid (BWFE) of KUB-2$_{kk}$ (1808 ± 240 g) and of KUB-2$_{nk}$ (1788 ± 231 g) were not significantly different (p>0.05). The figures are higher than their parents, KUB-1 (1600 g/hen) (Sartika et al. 2013; Iskandar & Sartika 2014). BWFE of 1600 -1800 g at the age of 22 weeks seems to the ideal weight for a hen to start producing the egg. Matawork et al. (2019) found out the BWFE of 24 weeks pullet of Ethiopian indigenous breed across agroecosystem of 1480 g, had lower egg production than the KUB-2 line. However, Haunshi et al. (2019) reported that Indian local Aseel selected for 5 generations had BWFE of 1669±10.6 g, which is to some extent close to the result of KUB-2 of this experiment.

Egg weight at first egg (EWFE) of KUB-2$_{kk}$ (31.34 ± 5.44 g) and KUB-2$_{nk}$ (31.32 ± 4.67 g) was statistically not different (p>0.05). As early as 18 weeks, few hens started to lay her small egg (Table 2). The average weight of egg at the age of 18 to 20 weeks was 30.01 ± 2.41 g and 29.99 ± 2.10 g respectively for KUB-2$_{kk}$ and KUB-2$_{nk}$. The older the hen the bigger the egg (Osei-Amponsah et al. 2015). The development of the egg size of the experimental hens followed the hypotheses. The average egg weight up to 24 weeks of age would only reach 35.7 g, which is not big enough to be hatched. According to SNI (Indonesian National Standard), the proper local day old chicken weight is 26 g as a salable chick. The size of the egg incubated can only reach as quickly as the hen reaches the age of 25 weeks by having 38 g egg. Therefore, the hens of this experiment can have their eggs incubated is at the age of 25 weeks by having the egg weight of 39 g, both for KUB-2$_{kk}$ and KUB-2$_{nk}$.

The average egg weight of both groups (KUB-2$_{kk}$ and KUB-2$_{nk}$) at the same age was relatively similar. At the age of 40 weeks, the average egg weight was 44.5 g and 44.8 g, for KUB-2$_{kk}$ and KUB-2$_{nk}$ respectively, and at the age of 44 weeks, the weight was around 46 g (Table 2). Egg size is influenced by the breed of the chicken, feed quality and amount given (Haunshi et al. 2019)reported on Indian local Aseel chicken which had a bigger size of an egg at the age of 40 weeks (48.9 g). After at 8th generation of selection the egg size was increasing 1.3 g compared to the 1st generation. Further, they mentioned that the size of an egg of 46 g was reached at the age of 32 weeks. Mengesha (2012) reported the range of egg weight of indigenous Ethiopian chicken was 42-48 g, and Ghanaian local chicken at the age of 22-48 weeks was at the range of 38 – 40.1 g (Osei-Amponsah et al. 2015). However, Ethiopian Koekoek chicken had higher egg size of 52.5 g (Shumuye et al. 2018).

Average egg production (AEP)

Average egg production (AEP$_{24}$) recorded for 24 weeks (20 – 43 weeks of age) of KUB-2$_{kk}$ (101.9 ± 27.8 eggs) and KUB-2$_{nk}$ (103.3 ± 25.9 eggs) (Table 3), did not significantly different (p>0.05). AEP$_{24}$ of KUB-2 line as the average of the whole population was 102.8 ± 26.6 eggs or 61.2 ± 15.8 %. However, the AEP$_{24}$ of KUB-2 is higher than KUB-1, which was reported (Sartika et al. 2013; Iskandar & Sartika 2014).

Variation of individual AEP$_{24}$ of KUB-2 at 4th generation was relatively smaller (25.87%) than of KUB-1 (33.59%) reported Sartika et al. (2018). Maximum AEP$_{24}$ of KUB-2 was 154 eggs in the first 24 weeks of production or 91.67%, whilst minimum individual AEP24 was 5 eggs or 2.98%. The KUB-2 AEP$_{24}$ seemed to have wide individual variation, showing that chance for further selection, however when compared to some selection results on indigenous chicken from other developing countries, our KUB-2 is much better. Haunshi et al. (2019) reported that Indian Aseel selected for 8 generations produced 78.6 eggs or 53.47% during 40 weeks of observation. The production was increased from their 1st generation, which only produced 59.5 eggs or 40.48%. Matawork et al. (2019) reported that Ethiopian local chicken raised traditionally in Gena Bossa district in high, medium and low altitudes, produced 38.73, 40.45, and 36.42 eggs/hen/year, respectively.

Recently Ethiopian government exported exotic breed to improve their local chicken (Terfa et al. 2019). This program might have been based on the report of (Wondmeneh et al. 2016) who compared egg production between Horro improve breed of local chicken with modern commercial ISA Brown, crossbred of ISA Brown X Horro, and indigenous

Ethiopian breed of chicken, showed that egg production recorded for 24 weeks of those evaluated breeds, were respectively 57,1% HH; 92,2% HH; 83% HH dan 27,1%. It seems that improved Horro breed selected for 7 generations, produced eggs as much as our KUB-1 chicken.

Peak egg production of KUB-2 was 75.4% at the age of 34 weeks. Sixty percent of henday production was obtained at the age of 24 weeks persisting up until 41 weeks of age, even KUB-2nk could persist more than 60% henday production up to 43 weeks of age (Figure 1). The egg production of KUB-2 chicken is much better than the egg production of KUB-1 (Sartika et al. 2013). Level of improvement of one breed will influence the level of egg production besides the quality and quantity of feed and drinking water, the length of exposure to light, management, including biosecurity, disease outbreak, the existence of parasites and another environment (Osei-Amponsah et al. 2015). As an example, Osei-Amponsah et al. (2015) added further information on local Ghana Savanah and local Ghana Forest breeds of chicken which produced egg poorly, but French Sasso breed of chicken would reach peak egg production up to 90% at the 6-8 weeks production phase.

According to individual egg production capability of KUB-2 hen at 4th generation, there were few hens (7.2% of 512 hens) produced eggs more than 80 % (Figure 2). In other words, there were 37 hens with 140.2 eggs in the first 24 weeks of age. The most number of productive hens about 28.1% of the population laid eggs more than 60% (109.8 eggs/24 weeks) and about 26.4% hens laid their eggs more than 70% (124.1 eggs) at the same period of production.

There were about 21% hens of the population laid eggs less than 50 %, this means that 71% of hens laid egg more than 50%. However, since the variation of individual egg production is still relatively high (25.87%), it gives us to be able to further selection to increase egg production and production stability.

Padhi (2016) stated that selection in indigenous chicken would increase permanent production although it needed quite some time. In Ethiopian local Koekeok breed of chicken produced 180-240 eggs/hen/year (Shumuye et al. 2018). At the meantime KUB-1 just produced 160-180 eggs/ hen/year (Sartika et al. 2013), so KUB-2 produced about 102 egg/hen in the first 6 months egg production period, will need about another year selection to reach the minimum target of 180-220 eggs/hen/year.

FCR and mortality

Feed Conversion Ratio (FCR) is a ratio of the weight of feed intake and the weight of egg produced in a certain time of observation. However, since the daily feed consumption was assumed around 100 g/hen, the total amount of feed consumed was calculated roughly according to number days during observation. The assumption was based on feed consumption of KUB-1 of around 80-85 g/hen/day at the level of 50% egg production (Sartika et al. 2013). Since the egg production of KUB-2 was 60%, their daily feed consumption was assumed to be 100 g/hens/day. The FCR values according to the age of the hens are presented in Table 4. The FCR figures maybe a little bit bias, but it was treated all the same to all hens, with their accurate daily individual egg recording.

Table 4. Feed conversion ratio (FCR, g feed/g egg) of KUB-2 chicken at 4th generation

Age at week		KUB-2kk[1] (n=190)	KUB-2nk (n = 322)
20-24	Average, (g feed/g egg)	9.01±5.18	9.39±6.99
	CV (%)	57.56	74.53
25-28	Average (g feed/g egg)	4.14±0.41	3.81±0.17
	CV (%)	9.77	4.49
29-32	Average (g feed/g egg)	3.48±0.24	3.41±0.09
	CV (%)	6.77	2.82
33-36	Average (g feed/g egg)	3.13±0.14	3.17±0.05
	CV (%)	4.44	1.43
37-40	Average (g feed/g egg)	3.41±0.18	3.51±0.19
	CV (%)	5.30	5.49
41-43	Average (g feed/g egg)	3.57±0.14	3.74±0.12
	CV (%)	3.91	3.23
25-43	Average (g feed/g egg)	3.54±0.37	3.53±0.26
	CV (%)	10.43	7.34

[1] kk = Yellow shank; nk = Non-yellow shank
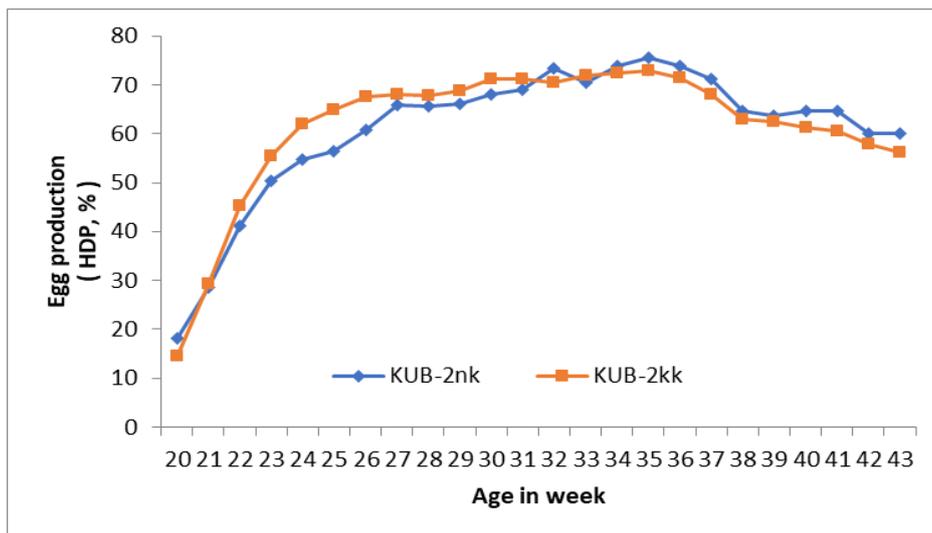
kk: Yellow shank; nk: Non-yellow shank

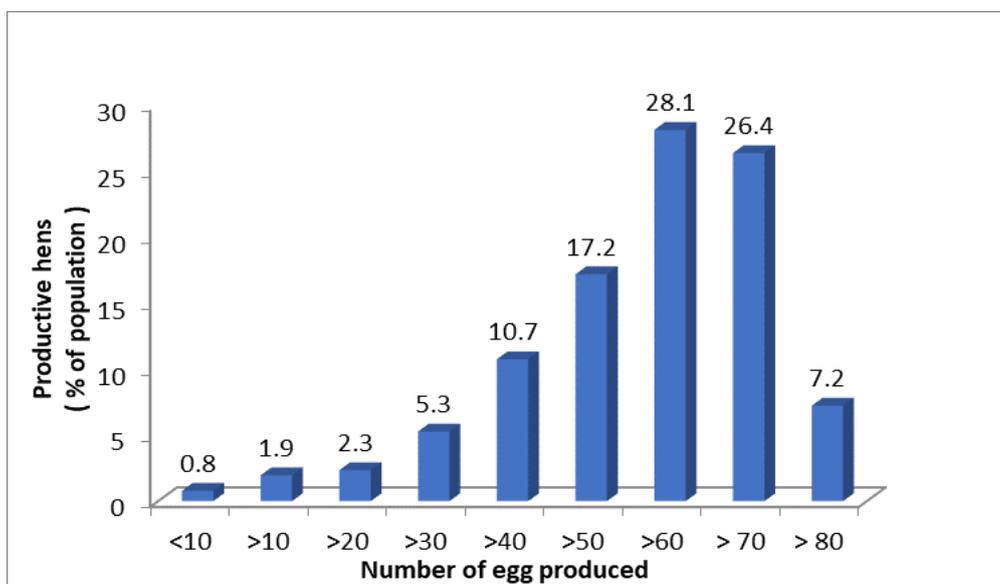**Figure1.** Egg production of KUB-2 chicken at 4th generation

Figure 2. The egg production capacity of KUB-2 chicken at 4th generation

As it is presented in Table 4, the very poor FCR (9.4) at the age of 20-24 weeks was due to a small number of hens that laid eggs (10% of the total population), whilst the hens consumed as much as an adult hen. The number of hens which laid the egg was increasing and reached a level of 40% at the age of 24 weeks (Figure 1). The size of the egg was also smaller (30-35 g), which was not good enough for incubation. The age of 25- 43 weeks seems to be the best production phase for evaluating FCR. FCR of KUB-2 was 3.5, which is better than the FCR of KUB-1 (3.8) (Sartika et al. 2013). Wondmeneh et al. (2016) reported of FCR of 4 breeds were 3.4, 2.4, 3.3 and 7.1 respectively for improved Horro, commercial ISA-brown, crossbred ISAxHorro and indigenous Ethiopian breeds of chicken. The mortality rate during the observation was very low; there only 5 hens died of 517 hens or about 0.97% mortality.

CONCLUSION

Laying performance of KUB-2 chicken at 4th generation was much better than their parent, KUB-1. Grouping the line to the yellow shank and non-yellow shank did not influence laying performance. AFE, BWFE, and EWFE of KUB-2 were respectively 156.9

days, 1795.4 g and 31.26 g with EP_{24} was 102.8 eggs or equal to about 61.2%. At the age of 25 weeks, the size of an egg (39 g) was suitable for incubation. The FCR of 25-43 weeks of age was 3.54. Hens mortality during the experiment was 0.98%.

ACKNOWLEDGMENT

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