

The Livability of Bovans Brown Parent Layers Raised in Commercial Breeder Farm, Ethiopia

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Abstract: In order to meet its chicken meat and egg demand for its growing population and produces export surpluses, Ethiopian poultry sub-sector should move away from the traditional scavenging family poultry system (TFP) to the improved semi-scavenging family poultry system (IFP) and increase the scale of specialized poultry. The Bovans brown (BB) genetics are one of familiar exotic breed in Ethiopia. A prospective cohort study was conducted to estimate their livability and evaluate body weight and age as predictors of livability. There is direct proportional trend in body weight increment with slight difference with the standard. Both sex groups showed excellent growth with percent uniformity of 96.7% for males and 95.3% for females. Overall, 161 chickens died with the total weekly chicken death rate ranged from 0.00% to 1.79% varying from 0.00% to 3.14% in males and from 0.00% to 1.57% in females. On the other hand the percentage of cumulative mortality was 9.91% (46/510) for male chicken and 2.94 (115/4020)% for female and 3.69% (161/4530) for all. The mean mortality of chicken was 4.24 per week being 2.42 for males and 6.05 for females. The loss of female chickens exceeded that of male chickens, CV of 2.38 for the former and 1.82 for the latter. Using regression analysis, the identified significant predictors of mortality were age in weeks (Coef. = -0.78; p = 0.011) and body weight in gram (Coef. = -0.0086; p = 0.006). As both parameters get increased, mortality of chicken on the contrary got reduced. The overall livability of bovans brown breeder chicks at the end of rearing period was 96.45% (90.98% for males and 97.14 for females). Bovans brown parent stock layer chicks demonstrated excellent performance and livability.

Keywords: Body Weight, Bovans Brown, Chicken, Livability, Mortality

1. Introduction

Producing a big quantity of meat for getting quality animal protein in our daily life plays a significant role to our national health strategy as well as economy. Poultry as a livelihood as well as a cheap source of animal protein improving the family diet contributes poverty reduction, new employment generation, women empowerment and strengthened nutritional status [15]. An increasing human population, greater purchasing power and urbanization have been strong drivers of growth and industrialization of the poultry sector [8].

Chickens are widely kept in Ethiopia [9], with total

population estimated to be about 60 million of which 90.8%, 4.4% and 4.8% were reported to be indigenous, exotic and hybrid, respectively [7].

Despite meaningful contribution to poultry meat and egg production, the economic contribution is not still proportional to this huge indigenous chicken numbers [2, 9]. Ethiopian poultry sector is not yet to satisfy the local growing needs of customers. In order to meet its chicken meat and egg demand for its growing population and produces export surpluses, Ethiopian poultry sub-sector should move away from the traditional scavenging family poultry system (TFP) to the improved semi-scavenging family poultry system (IFP) and increase the scale of specialized layer and broiler production (specialized poultry). This transformation will make a

substantial contribution to reducing poverty and malnutrition among rural and urban poor [17].

There are over 350 different breeds of chicken worldwide [16]. With the aim of improving poultry productivity, different breeds of exotic chickens like Rhode Island Red, Australorp, New Hampshire, White Leghorns and many other exotic breeds of chicken were imported and disseminated to rural farmers and urban-based small-scale poultry producers in Ethiopia [18].

In Ethiopia, both broiler and layer parent stock are imported from other countries either in the form of day old chicks (DOCs) or hatching eggs. The poultry companies importing parent stocks own hatcheries and multiplication facilities for producing DOCs for their own farms or for dissemination to other smaller farms [8].

The bovans brown (BB) genetics are one of familiar exotic breed in Ethiopia which is owned by institute de selection animale (ISA), which is part of multi-species breeding company Hendrix Genetics (www.isapoultry.com). The BB is a white egg layer designed to best meet the challenges of today's modern egg industry; producing very large quantities of uniformly sized, strong-shelled eggs at a very low feed conversion ratio. At the same time it is very forgiving when the conditions turn temporarily unfavorable [5]. The rearing period (0-17 weeks) is, by far, the most critical time in the life of a laying chicken. During this period, development of physical structures as well as the physiological foundation occurs for the productive life of the hen. Well managed brooding and grow out periods will help build a strong, healthy bird capable of meeting or exceeding expectations for performance. Errors made during this time are very difficult to overcome. One should strive to achieve the target body weight with good uniformity in a properly vaccinated flock. All these lead why the research focus on the brooding stage to maturity (0-18 weeks).

There are several published works on the performance and livability of different strains of chicken [4, 10, 14]. Ali *et al.* [3] studied the effect of density and flock size on growth performance of native chicken and concluded that flock size 30 birds/flock performed better at the density level 0.279 m² /bird than other densities and other flock sizes. Better egg hatchability and higher chicks livability rate were also reported to depend on hen:cock ratio in Fayoumi layers [19].

Though breeds differ genetically in their immune responsiveness to the antigen, and being protected following challenge; difference in their susceptibility to the virulent challenge virus needs to be ruled out in order to facilitate the improvement of disease-resistant traits [1].

Therefore the objectives of this study were, to assess the livability of bovans brown chicken from day old to 18 weeks of age, to evaluate the age and weight of the birds as predictors of mortality and appraise the growth of bovans brown chicken from the age of day old to 18 weeks of follow up period.

2. Materials and Methods

2.1. Study Area

The study was undertaken at parent stock unit of the layer breeder farm in Sodo district of Guraghe Zone of the Southern Nations and Nationalities Peoples Regional State. It is situated at 115 km south eastern of Addis Ababa at an altitude 2,056 meters above sea level with Latitude 8°19'60.00" North and Longitude: 38°39' 59.99" East near to Butajira. The climate is classified as warm and temperate. It has an average annual rain fall from the range of 1284 to 1484 mm precipitation. The rain fall over much of the areas is typically bimodal with the major rainy season extending from June to September and the short rainy season occurring from February to April with mixed farming system. The mean annual maximum and minimum temperature of the area is 21.2°C and 16.8°C respectively.

2.2. Farm Description and Flock Management

The farm was placed as far as possible from other poultry houses. The farming is intensive production system typically carried out at so-called complexes. The complexes mainly contain feed processing unit, hatchery unit and a parent stock unit with controlled sheds/house where the chicks are raised. The parent stock unit is a confined breeder layer farm involving 4530 (510 male and 4020 female) parent layers chicks kept under highly intensive production system of indoor conditions with a strict bio-security level as each phase of production treated as separate batch, according to the principle of "ALL IN – ALL OUT".

The farming started with DOCs which is bought for rearing. In this farm there are four interrelated tasks- Poultry management, Feed processing, Hatchery Management and Biosecurity control and management. By focusing on these critical key management practices, the farm had an opportunity to reduce the risk/loss and total cost of production.

The rearing house (including wall, roof and floor) was structurally sound, vermin-proof, well maintained and insulated, leak and water proof, easy to clean and disinfect. The farm has standby generators and water pump.

The management pattern of the study flock were entirely intensive production farming system where chickens managed in highly confined environment, higher investment, with intensive inputs such as feed, housing, health, and modern techno-management systems. The DOCs were transported to the study farm and reared for 18 weeks under deep litter system during which they were managed with good management, which includes, but was not limited to, good quality feed, housing and proper management practice as described by manufacturer management guide for layer breeders [6].

2.3. Hygienic and Sanitation Protocols

Before the arrival of the DOCs, all the manufacturer's hygienic and sanitation protocols were accomplished. The rearing house was thoroughly cleaned, disinfected and

sprayed against external parasite. Entries were controlled and restricted to the minimum number of entries with strict biosecurity procedures. At the entrance, there was footbath for human and car wash dip that contained virocid and biosafe to prevent biological hazards. Nonetheless, during entering the farm, workers was obliged to put his or her foot on footbath at the gate entrance to disinfect the shoe to reduce the chance of introduction of the disease to the farm.

Farm equipment's were designed for easy access and removal, for clean-out, maintenance and bio security consideration. Always, only new egg trays and egg boxes were used. Farm workers were not allowed to keep poultry or pet birds at home or come into contact with other poultry. Entrance of people or material from other poultry farms was totally banned. Professionals entering to chicken houses (workers, veterinarians, consultants...) had to take a shower, change footwear and use chicken house-specific protective clothing and disinfect boots at the gate of the pen before entry. Truck drivers were never allowed to enter to chicken houses. Dogs and cats are not kept in the farm.

2.4. Health Management

The birds were vaccinated against Marek's, New castle disease (NCD), IBD, Fowl Typhoid, and Fowl Pox, as outlined by the manufacturer vaccination programs as shown in Table 1. In addition, the broad spectrum antibiotic Oxytetracycline 20% powder, (0.5 g/l water), and Amoxicillin powder (10 mg/kg bw), was given as veterinary intervention when birds are sick and as prophylaxis whenever necessary. Flock deworming using anti-helminthic agents Piperazine (15 mg/ kg), Amprolium 20% (0.3 g/l water) and Levamisol (35 mg/kg) were administer orally for consecutive 3 days prior to vaccination as prescribed by the manufacturer deworming programs. Multi-vitamins (Vita-chick, and Amino-Vet) were also administered in drinking water as supplements daily for 30 consecutively days and after vaccination.

At the age of 10 weeks after the starter and rearing feeding phase was terminated, all chickens were de-beaked using electric beak trimming matching.

Table 1. Vaccination schedules for all experimental breeds.

Age administered	Disease encountered	Type of vaccine	Rout of administration
Day 1	Marek's disease	Marek's	Sub-cutaneous
Day 3	NCD	HB1	Ocular
Day 7	Gumboro disease	IBD (Gumboro)	Drinking water
Day 16	Gumboro disease	IBD (Gumboro)	Drinking water
Day 21	NCD	Lasota strain vaccine	Drinking water
Day 45	Fowl typhoid	Fowl typhoid	Sub-cutaneous
Day 63	NCD	Lasota strain vaccine	Drinking water
Day 90	Fowl typhoid	Fowl typhoid	Sub-cutaneous
Day 105	Fowl pox	Fowl pox	Wing web
Day 120	NCD	Thermostable	Ocular
	Every 8 weeks	Lasota strain vaccine	Drinking water

2.5. Lighting, Feeding and Watering

The chicks were reared on a 5 – 10 cm straw deep litter treated by spraying biosafe. The wetted litter was changed with disinfected, dried and clean `teff` straw whenever necessary. The bedding litter lasted for three months.

During the first 4 days, the chicks were maintained under a maximum light regime (24 hours) with a quite high intensity (30-40 lux) from infrared bulb to encourage intake of water and feed. Afterwards, the light duration and intensity gradually reduced by 2 hours for each one week increment of bird's age until reach to 14 hours of light duration at five weeks of age.

The chicks were fed starter diet from day old till 6 weeks old, during which the feed was offered ad libitum in the first week of age. From 6 weeks to 12 weeks of rearing period, Grower feed was offered to the chicks four times per day based on daily standard feed intake as described by manufacturer management guide manual. About 60% of daily feed amount was given in the morning.

But, the water was freely access for the chickens without any limitation. Weekly bird weighing was essential, so that the appropriate quantity of feed to issue was calculated.

2.6. Study Design

A longitudinal cohort study was undertaken to generate information on the mortality and livability of chickens that were followed up for 18 consecutive weeks. A total of 4530 bovans brown parent stock day old chicks (DOCs), bred by ISA companies and imported were followed up starting from November, 2019 to March, 2020.

Records on age of birds, mortality, morbidity, feed consumption in every day; body weight, lighting and uniformity records at the end of week, accompanied by structured performance table record book, was undertaken for 18 consecutive weeks and the flocks were photographed labeling at the end of the week. Illness and any disease-like symptoms (breathing, demeanor, neurological, discharge) in the flock was monitored daily and recorded in the rearing performance chart on remark column. Moreover, frequent follow up was undertaken by assistants and chicken keepers on any normal and abnormal dynamics, thereafter relevant data was also collected simultaneously on these observations.

At the end of the rearing period (18 weeks), the recorded performance tables of the flock and actual performance curves were compared to bovans brown parent stock rearing chart provided only as useful reference points on the

performance of a flock, but not in any way be interpreted as a guarantee of success.

2.7. Data Collection

Growth performance of the study chicks was evaluated by recording body weight gain, feed intake; feed conversion ratio and mortality during the 126 days follow up period. The required data was collected using a format prepared for this purpose. Individual body weights of the chicks were recorded at the end of each week. The number of death was recorded on daily basis. To calculate the livability rates of bovans brown chickens all deaths were counted and the loss of chickens attributable to the other reasons (except deaths) was excluded.

2.8. Data Analysis

The collected data was entered and managed in a Microsoft Excel spreadsheet and analyzed using Statistical Package for Social Sciences version 20 (SPSS v20.). Descriptive statistics was computed for weekly death rate, mortality rate, percent cumulative mortality and percent livability of chicken. In addition multiple regression analysis was carried out to assess the importance of body weight and age of chicken as predictors of mortality and therefore livability. A statistically significant association was said to

exist when $p < 0.05$.

3. Results

3.1. Body Weight

Altogether, 4530 chickens were observed prospectively. As presented in table 2, Growth of chicks closely followed the standard data despite differences in some weeks due to stressors. In male chickens, the mean body weight showed increment, however, when compared with the standard it was found to be lower for the first three consecutive weeks with percent uniformity of 61.3%, 48.4% and 60.7% for the first, second, and third week in that order. Later, on the fourth week, the mean body weight measure became somewhat comparable with that of the standard with percent uniformity of 92.8%. After this, it showed slight discrepancy from the standard till the eleventh week of the follow up period where and afterwards it became comparable with the standard with a percent uniformity ranging 94.3% to 99.3%. On week eighteen, end of the follow up, male chickens attained 96.7% uniformity. Unlike in male chickens, in females the mean body weight showed moderate difference from the standard with percent uniformity ranging from 74.9% to 98.2% with 95.3% for the last week of observation.

Table 2. Uniformity and body weight (actual and standard) of the parent chicken during the rearing period (18 weeks).

week	Male			Female		
	Actual mean b.wt (g)	Standard b.wt (g)	Uniformity (%)	Actual mean b.wt (g)	Standard b.wt (g)	Uniformity (%)
1	52.1	85	61.3	51.3	60	85.5
2	82.2	170	48.4	89.9	120	74.9
3	167.0	275	60.7	176.9	195	90.7
4	362.0	390	92.8	231.0	280	82.5
5	453.3	520	87.2	311.0	370	84.1
6	539.5	660	81.7	421.2	470	89.6
7	612.9	785	78.1	502.9	560	89.8
8	798.0	910	87.7	573.8	650	88.3
9	857.6	1035	82.9	694.3	740	93.8
10	996.0	1160	85.9	766.1	830	92.3
11	1210.0	1280	94.5	898.0	915	98.1
12	1321.0	1400	94.4	932.0	1000	93.2
13	1424.2	1510	94.3	999.0	1080	92.5
14	1614.3	1625	99.3	1118.5	1160	96.4
15	1656.0	1735	95.4	1198.1	1240	96.6
16	1787.0	1850	96.6	1296.0	1320	98.2
17	1899.0	1960	96.9	1345.0	1400	96.1
18	1992.0	2060	96.7	1401.0	1470	95.3

b.wt: body weight

3.2. Mortality

Overall, 161 chickens died during the follow up period. As presented in Table 3, the overall weekly chicken death rate ranged from 0.00% to 1.79% varying from 0.00% to 3.14% in males and from 0.00% to 1.57% in females. On the other hand the percentage of cumulative mortality was 9.91% (46/510) for male chicken and 2.94% (115/4020) for female and 3.69% (161/4530) for all. Higher death rates of chickens were recorded in the first five consecutive days of brooding period and over at the ended the first week. A medium

weekly mortality of chickens was recorded in the next five weeks, commencing from the second week of age until the end of the sixth week of rearing. A very low weekly mortality of chickens was recorded in the rest period of rearing, commencing from the sixth week until the rearing period was over at end of the week 18.

The mean mortality of chicken was 4.24 per week being 2.42 for males and 6.05 for females as summarized in Table 3. The loss of female chickens exceeded that of male chickens, CV of 2.38 for the former and 1.82 for the latter.

Table 3. Statistical summary of mortality in consecutive observed weeks (1 week to 18 weeks).

Mortality	No of observed weeks	mean	variance	SD	Range	CV
Male	18	2.42	19.37	4.40	16	1.82
Female	18	6.05	208.39	14.44	63	2.38
Total	18	4.24	114.18	10.68	63	2.52

No: number; SD: Standard deviation; CV: Coefficient of Variation

Using regression analysis, the identified significant predictors of mortality as presented in table 4 were age in weeks (Coef. = -0.78; $p = 0.011$) and body weight in gram (Coef. = -0.0086; $p = 0.006$). As both parameters get increased, mortality of chicken on the contrary got reduced.

Table 4. Statistical association of bird mortality with body weight and age of the chicken.

Parameters to be associated	B	Coef.	p	LCI	UCI
Age in weeks	11.28	-0.78	0.011	-1.377	-0.188
body weight	11.86	-0.0086	0.006	-0.014	-0.0026

3.3. Livability

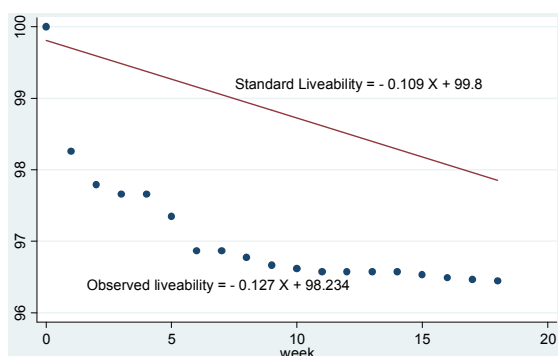
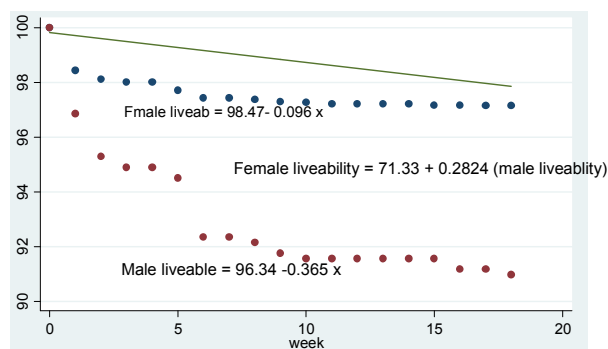
The overall livability of bovans brown breeder chicks at the end of 18th week (end of rearing period) was 96.45%. The higher death rate of chicken in the first five consecutive days of brooding periods resulted a sharp declining in the survival rate

from 100% to 98.2%. About 96.87% chicks survived by the end of sixth weeks of age. Within the last eleven weeks of observation the survival rate declined by less than 0.5%. The table presents the livability of the study birds compared to the standard livability.

Table 5. The livability of birds starting from brooding to pre-lay period.

Week	# Live chicken			Actual Livability (%)			Standard livability (%)
	Male	Female	Total	Male	Female	Total	
0	510	4020	4530	100.0	100.0	100.0	100.0
1	494	3957	4451	96.9	98.4	98.3	99.8
2	486	3944	4430	95.3	98.1	97.8	99.6
3	484	3940	4424	94.9	98.0	97.7	99.4
4	484	3940	4424	94.9	98.0	97.7	99.3
5	482	3928	4410	94.5	97.7	97.4	99.2
6	471	3917	4388	92.4	97.4	96.9	99.1
7	471	3917	4388	92.4	97.4	96.9	99.0
8	470	3914	4384	92.2	97.4	96.8	98.9
9	468	3911	4379	91.8	97.3	96.7	98.8
10	467	3910	4377	91.6	97.3	96.6	98.7
11	467	3908	4375	91.6	97.2	96.6	98.6
12	467	3908	4375	91.6	97.2	96.6	98.5
13	467	3908	4375	91.6	97.2	96.6	98.4
14	467	3908	4375	91.6	97.2	96.6	98.3
15	467	3906	4373	91.6	97.2	96.5	98.2
16	465	3906	4371	91.2	97.2	96.5	98.1
17	465	3905	4370	91.2	97.1	96.5	98.0
18	464	3905	4369	91.0	97.1	96.4	97.9

= Number

**Figure 1.** Livability of the chickens starting from brooding to pre-lay period.**Figure 2.** Schematic comparisons of both sex chick livability to the standard livability of bovans brown breeder at the end of rearing period.

Figures 1 and 2 describe the livability percentage of bovans brown parent chickens on weekly basis from week 0 up to week 18. As presented in Figure 1, there is significant difference in overall livability found in this observation compared to the standard (98%) ($p = 0.003$).

The livability of female chicken (97.14%) was higher than that of male chicken (90.9%) and there was a significant variation ($p < 0.005$) between the two sex groups (Figure 2). During the six consecutive rearing weeks, huge loss of male chicks have been recorded, resulting sharp declining in the livability rate from 100% to 92%. Compared with female chicks a higher mortality of male chickens was observed starting the first week and this higher rate of mortality continued until the 6th week. By the end of 6th week, the livability of male chickens was reduced to 92%, which is significantly lower ($p < 0.005$) than female chickens (compared at this same age limit). After this age, a very low mortality of male chickens occurred and by the end of the observation the livability rate declined only by 1%, resulting the overall livability of about 91%.

4. Discussion

Despite limited past attempts to improve the chicken productivity in Ethiopia through the introduction of high performing commercial breeds, now a days, huge number of parent DOCs are imported from different countries to Ethiopia by small scale and large scale intensive farms and by research institutes [8, 11]. To our understanding, this was probably the few study part undertaken in Ethiopia to estimate the livability rate of the parent-stock chicken in private breeder farm.

In the present study, though daily body weight gain of the chicken was good, there was significant bodyweight difference compared to the standard body weight of the chicken in weekly body weight measurement. Moreover, body weight had inversely proportional effect on chick mortality.

Bodyweight achievement in reference to their standard according to the age of the chick is very critical and has multidimensional influence on those synthetic breeds. Early detection of abnormal weight gain is of extreme importance to determine what corrective actions must be taken. Late attempts to correct low body weight are not efficient at improving body composition and frame size [6]. Therefore, weekly body weighting and comparing to the standard assist to follow the whole performance of the chicks.

In the current study, about 96.45% birds survived up to the 18 week of age (pre-lay period). This was a little bit equivalent to the standard reference rate (97.9%). Livability of bovans brown parent in this study was higher than livability rate up to 16 weeks of age of commercial bovans brown reported by [18]. Similarly, it was high rate of livability when compare to livability reports of Sonali chicks breed in intensive system (90.8%) and in semi-intensive farming system (94.4%) [12]. This difference might be due to the difference among breeds, farming system and

management condition among poultry production and households.

In the present study, an inverse trend of livability was recorded among body weight and age of chicken. In consistent with the present finding a similar inverse trend was reported among Fayoumi layers [19].

The present study revealed that livability had a significant variation ($p < 0.005$) between the two sex groups female (for 10 unit male livability increments, the female livability rate increases by 2.8) showing higher livability of female chicken (97.14%) than that of male chicken (90.9%), which possibly might be because of their differences in genetic makeup. Early mortality of chicks, huge early loss of male chicks (during the first six consecutive rearing weeks) have been recorded. The differences observed for males and females would be in line with the results obtained in the study by Leitner *et al.* [13], they observed large differences in the mortality rate between males and females from week two to week eight of life. These differences were found in the activity of the T and B lymphocytes, despite the participation of other regulatory cells could not be ruled out. They concluded that females developed effective immune responses before than males. This difference in the rate of development of immune response is what could make males more susceptible to pathogens, and therefore, have higher first week mortality [20]. Beside this the livability was high in female chicks than that of male because of their body weight. The performance failure probably influences the livability of the chicken.

5. Conclusions

This study generated baseline information on the performance, mortality and livability of commercial bovans brown parent stock layer chicken reared in a commercial poultry farm. The study demonstrated excellent performance, reduced mortality and excellent livability of bovans brown parent stock layer chicken imported from the Netherlands was comparable with the standard. Male chicken showed slightly higher percent uniformity compared to females. The study also revealed that body weight and ages of chicken were predictors of mortality with an inverse trend and females chicken exhibited superior livability compared to male chicken. Thus, various stressors of chicken rearing and the causes of reduced body weight of female chickens and increased mortality of male chickens have to be seriously investigated and corrective measures have to be undertaken to improve their performance and livability.

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