ON-STATION AND ON- FARM EVALUATION OF THREE DUAL PURPOSE EXOTIC CHICKEN STRAINS IN HOMA DISTRICT OF WEST WOLLEGA ZONE, ETHIOPIA

MSc. THESIS

BY

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On-station and On- Farm Evaluation of Three Dual purpose Exotic Chicken Strains in Homa District of West Wollega Zone, Ethiopia

By

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DEDICATION

This thesis work is dedicated to my father Terefe Tola, who supported me throughout my tertiary education.

STATEMENT OF THE AUTHOR

First and foremost, I declare that this thesis is my legitimate work and all the material sources used have been duly acknowledged. This thesis is submitted in partial fulfillment of the requirements of Master of Science Degree in Animal Production to Jimma University College of Agriculture and Veterinary Medicine (JUCAVM). I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma or certificate. It is made available at the University's Library to borrowers as per the rules and regulations of the Library.

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BIOGRAPHICAL SKETCH

The Author Chali Terefe Tola was born from his father Terefe Tola and his mother Birhane Taye in West Wollega Zone, Homa Woreda on May 6/1986 G.C. He completed his elementary and secondary education at Homa elementary school and Biftu Ghimbi high school, respectively. He joined Alage Agricultural Technical Vocational Education Training (ATVET) College and graduated with diploma in Animal Science in July 30/2006 GC. Soon after his graduation, Chali Terefe was employed by Homa woreda agricultural office and worked as development agent and supervisor for 3 consecutive years. In the academic year of 2009 G.C he joined Jimma University College of Agriculture and Veterinary Medicine for professional upgrading and graduated with a BSc Degree in Animal Science inApril23/ 2014 G.C. Soon after graduation Chali was employed by Oromia Livestock and Fishery Resources Development office and assigned to Homa woreda, where he worked in different positions. Finally, he joined School of Graduate study of Jimma University, College of Agriculture and Veterinary Medicine in September 2016 G.C to pursue his Master of Science Degree in Animal Production.

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LISTS OF ABBREVIATIONS

AH	Albumen Height
ANOVA	Analysis of Variance
AOEL	Age at onset of Egg Laying
ADG	Average Daily Gain
^{0} C	Degree Celsius
CSA	Central Statistics Agency
CRD	Completely Randomized Design
DRB	Dominant Red Barred
EIAR	Ethiopia Institute of Agricultural Research
EW	Egg Weight
g	Gram
GLM	General Linear Model
HH	Household
HU	Haugh Unit
ILRI	International Livestock Research Institute
JUCAVM	Jimma University, College of Agriculture and Veterinary Medicine
Kg	Kilo Gram
m.a.s.l	meter above sea level
NCD	New Castle Disease
PK	Potchefstroom Koekoek
SAS	Statistical Analysis System
HDAO	Homa District Agricultural Office
HDLFDO	Homa District Livestock and Fishery development Office
ELMP	Ethiopia Livestock master plan
TSS	Technical Services and Supplies

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ABSTRACT

A total of 225 SassoT44, Koekoek and Dominant Red Barred dual purpose exotic breed strains of chickens were obtained from JUCAVM hatchery and transported to Homa Districts of West Wollega Zone. The chicks were studied in two phases on station (brooding stage) and on farm (grower and mature stage) under farmer management condition. Mean feed consumption, rate of growth, feed conversion ratio, were studied for brooding stage (8weeks) and mean mortality, body weight gain, efficiency of egg production and egg quality characteristics parameters were used as comparative evaluation during the grower (9weeks) and mature stage (24weeks). The data were analyzed by SAS 9.3 version software using proc. GLM with Tukey HSD. The results obtained revealed that Dominant Red Barred chicks had significantly ($P<0.05$) higher mean hatching weight (37.21 g/chick) than the others. SassoT44 had significantly ($P<0.05$) higher mean daily feed consumption (45.75g/day/chick) than the other two breeds studied. The sasoT44 (2.88) and Koekoek (3.04) had higher significant ($P<0.05$) difference than Dominant red barred (3.81) breed strain in mean feed conversion ratio. SassoT44 attained mean body weight of 893.057g/head at the end of brooding period, the value of which was significantly ($P<0.05$) higher than the others. The overall daily gain of SasoT44 (15.03g/d) was significantly ($P<0.05$) higher than Koekoek (12.3g/d) and Dominant red barred (10.43g/d) during brooding stage. There was no significant difference ($P>0.05$) among all the three breed strains of chicks in rate of mortality during the brooding period. The SassoT44 and koekoek attained body weight 1.37kg/head and 1.27kg/head at an age of 17 weeks, respectively which was significantly ($P<0.05$) higher than that of the Dominant Red Barred (0.96kg/head). The mean body weight recorded from SassoT44 (2.40kg/head) at an age of 22 weeks was also significantly ($P<0.05$) higher than Koekoek (1.90kg/head) and Dominant red barred (1.33kg/head). SassoT44 breed of chicken reached an age of sexual maturity earlier than the others ($P<0.05$) as measured by age at first egg (157 days). The average daily eggs produced from SasoT44 (0.60) and Koekoek (0.59) breed strains of chickens during the first 150 days of laying was significantly ($P<0.05$) higher than that of Dominant Red Barred (0.42). SassoT44 and Koekoek were found to be superior ($P<0.05$) than the Dominant Red Barred chicken strain in mean egg weight, albumen weight, yolk height, and there was no significant difference ($P>0.05$) among all three breeds of chickens in other egg quality parameters. Generally, the results of the current study indicated that the production performances of SassoT44 and Koekoek breed of chickens were significantly better than that Dominant Red Barred breed strains of chickens while there was no significant variation in egg quality parameters. SasoT44 and Koekoek breed strains can be considered for future selected breed strains to improve the production and productivity with appropriate management and disease control in the area.

Key words: - Dual purpose, Exotic breed, brooding stages, grower stage, mature stage, farmer management, production performance, Egg quality, Homa District

1. INTRODUCTION

Poultry production is an area of livestock production with significant contribution to human food production. Among all livestock species, poultry appears to be the most suitable and practical intervention to improve the rural livelihoods in developing countries *(*Simainga, *2011).* Poultry meat accounts for about one-third of global meat production and consumption, and egg production on a weight basis, is estimated to be 80% of that of poultry meat production (Scanes, *2007*). In Ethiopia, the word poultry is synonymous with chickens. The latest estimate of chicken population in Ethiopian is reported to be about 60 million of which indigenous chicken comprises of about 90% and the remaining 4.39% and 4.76% are hybrid and exotic chickens, respectively (CSA, 2017). In Ethiopia, Poultry production is practiced in rural and urban areas that play a considerable role for livelihood of the population as a source of food (eggs and meat) and family income. The production system is classified as village, small-scale and commercial based on objectives of the producer, type and number of animals and management systems followed (Alemu and Tadelle, 1997). Village chicken is the first investment step on the ladder out of poverty because of its short generation interval, quick turnover rate, higher feed efficiency and low labor and land requirements (Ojedapo *et al.*, 2008). About 95.86% of the total national poultry products (eggs and meat) are contributed by indigenous chickens kept under village management system while the remaining1.35% is obtained from intensively kept exotic breed of chickens and 2.79% are obtained from hybrids (CSA, 2017). Poultry meat and eggs are affordable sources of protein compared to that of large animal products and poultry consumption in Ethiopia is commonly high during holidays (*ILRI, 2000).*

Despite the fact that Ethiopia own the largest indigenous chicken population in Africa, the annual egg and meat production of the country is disproportionally low. Ethiopia chicken industry which is still in its infancy holds considerable potential for growth, especially when considering that average per capita poultry consumption of 0.5 kg is among the lowest in the world by comparison, per capita consumption in Sub-Saharan Africa which is 2.3 kg. Ethiopia's annual chicken meat production is currently about 50,000 metric tons, with yearly imports of about 1,000 metric tons (Francom, 2017).

The production and productivity of indigenous chicken is low not only due to the failure to use inputs but also attributed to their low genetic potential. The mean annual egg production of indigenous chickens is estimated at 40-60 small eggs with thick shells and a deep yellow yolk color (CSA, 2017). The carcass weight of local chickens at maturity varies from 1.045kg to 1.292kg for male and from 0.642kg to 0.874kg for female (Halima, 2007). About 40-70% of the village chicks hatched die during the first 8 weeks of their life, mainly due to disease and predation (Tadelle and Ogle, 2001). About half of the eggs produced have to be hatched to replace chickens that have died and the brooding time of the laying bird is longer, with many brooding cycles required in order to compensate for the unsuccessful brooding (Tadelle and Olge, 1996). Growth and production traits of a bird indicate its genetic constitution and adaptation with respect to the specific environment (Ahmed and Singh, 2007). Though, there is huge chicken population and their production potential is limited because of poor husbandry practice and low emphasis given to genetic improvement of the indigenous chicken. This above situation necessitated to introduction and evaluation of exotic breeds to improve the livelihood of the rural poor farmers by providing improved extension advice and services and exploit the capacity of the sector to boost rural productivity by raising incomes, providing employment and alleviating poverty. Production and productivity of the village system should be improved through the type of chicken breed used, management and husbandry practices applied. This calls for designing national poultry research commodity aiming to improve egg and meat production and productivity on sustainable basis, improving nutritional quality, import substitution, sustainable supply of raw materials for agro industries and broadening the opportunity to exploit the potential export markets (EIAR, 2016).

From introduced exotic breeds of chickens; Dual purpose chicken strains are better suited under the Ethiopian small holder farming conditions and are most appropriate for farmers interested in both egg and growth traits. Exotic birds with better adaptations to wider agro-ecologies and comparatively less management could be the right choice in the Ethiopian villages. The most widely distributed dual purpose exotic breed of chicken in rural Ethiopia was Rhode Island Red. Now SasoT44, koekoek and Dominant Red Barred are of the introduced chicken breed with the objective of improving productivity as a country (Wondmeneh *et al.,* 2016).

Homa district of West Wollega Zone is not exception to these above situations. Exotic chicken have been distributed within the farming population of Homa district by Ministry of Agriculture and Rural Development during the last three decades. The exotic breeds of chickens distributed in the district included Rhode Island Red and SasoT44. Recently, a private investor, known as “Ethio- Chicken” provided day old chicks of SassoT44 breed of chicken along with appropriate commercial starter feed and vaccination for youth group organized into micro-enterprise by reasonable price. It was planned to distribute the chickens to the farming community of the district at the age of two months. SassoT44 is a dual purpose commercial breed originated in France (Fasil *et al., 2016).* Potchefstroom Koekoek was bred at the Potchefstroom Agricultural College during the 1950s in South Africa. This breed is a composite of the White Leghorn, Black Australorp and Bared Plymouth Rock. Dominant Red Barred breed is reported to be specialized breed of chicken adaptable to extensive, free range, backyards or rural village conditions of developing countries (Miln, 2017). Currently, because of the shortage of cultivating land, lack of grazing land, rapid population growth and urbanization, unemployment of youth and high protein demand of humans, chicken has become the most preferred animal in the district. Unfortunately, however, there is no information on the production performance of different exotic breeds of chickens distributed in the Homa district including that of SassoT44 so far.

Therefore, the major objective of this research project was to evaluate the growth and production performance of SassoT44, Potchefstroom Koekoek and Dominant Red Barred dual purpose exotic breed strains in two phase on station (during brooding stage) and on farm under farmer management production system in Homa district with the following specific objectives;

- To compare on station brooding performance of the three dual purposes exotic breed strains of chicks.
- To compare the production performances and egg qualities of the three dual purpose exotic breed strains under farmer management condition.

2. LITERATURE REVIEW

2.1 Poultry Production System in Ethiopia

Among all livestock species, poultry appears to be the most suitable and practical intervention to improve the rural livelihoods in developing countries including Ethiopia (Simainga, 2011). Poultry can be reared under different management and production systems, based on breed type, input and output level, mortality rate, purpose of production, production performance and number of chicken reared *(*Yenesew *et al.,* 2015). In Ethiopia, poultry production systems show a clear distinction between the traditional, low input system on the one hand and modern production system using relatively advanced technology on the other hand (Alemu, 1995). The production system is classified as village, small-scale and commercial based on objectives of the producer, type and number of animals and management systems followed (Alemu and Tadelle, 1997).

2.1.1 Village/Backyard Poultry Production System

Village or backyard poultry production system is practiced in rural areas of the country. The traditional poultry production system comprises of the indigenous chickens and characterized by small flock size, low input and output and periodic devastation of the flock by disease. There is no separate poultry house and the chickens live in family dwellings together with human beings. They play a critical role in providing economic, social and nutritional benefits to their owners without or with little input supply in the village smallholder scavenging system (Solomon 2007). However, they largely differ in production, health and reproductive performances (Reta, 2009) and also constrained by feed and disease crisis as well as predators and inadequate housing (Tadelle and Ogle, 2001; Halima *et al.,* 2007; Reta, 2009). Newcastle disease (NCD) under scavenging system is the major devastating disease (Tadelle and Ogle, 2001; Halima *et al*., 2007).

Village poultry is rarely the sole means of livelihood for the household but is one of a number of integrated and complementary farming activities contributing to the overall well-being of the household. There is no reliable data indicating the annual contribution of village poultry for the national economic development in Ethiopia. Nevertheless, it is believed that rural poultry accounts for 99% of the national total production of poultry meat and eggs in Ethiopia

(Tadelle *et al.,* 2000). Indigenous chicken based village poultry provides major income-generating activity from the sale of birds and eggs. Eggs provide a regular income while the sale of live birds provides a more flexible source of cash as required. Village poultry is a source of self-reliance for women, since the sale of live birds and eggs are decided by women (Aklilu *et al.,* 2007), both of which provide women with an immediate income to meet household expenses. Rural family poultry of indigenous chickens are a valuable asset to local populations as they contribute significantly to food security, poverty alleviation and the promotion of gender equality, especially in disadvantaged groups and less favored areas of rural Africa including Ethiopia. Village Poultry keeping uses family labor, and women (who often own as well as look after the family flock) are the major beneficiaries (Gueye, 2000).

For the Ethiopian food deficient smallholder farmers' family poultry represents one of the few opportunities for saving, investment and security against risk. There is no purposeful feeding of chickens and scavenging is almost the only source of diet. The major components of scavenging feed resource base are believed to be insects, worms, seeds and plant materials, with very small amounts of grain and table left over supplements from the household (Dessie, 1997).

The traditional poultry production system is characterized by small flock sizes, low input and output and periodic devastation of the flock by disease. Young chicks are left scavenging together with adult birds having to compete for feed and becoming an easy prey for predators and spread of diseases. Very often birds do not get enough water, or they get dirty water, which may transfer diseases (Yenesew *et al.*, 2015).

There is no separate poultry house and planned breeding under the village/backyard poultry production system and it is by natural incubation and brooding that chicks are hatched and raised all over rural Ethiopia. A broody hen hatching, rearing and protecting few number of chicks (6-8) ceases egg laying during the entire incubation and brooding periods. The bio-security of the traditional poultry production system is very poor and risky, since scavenging birds live together with people and other species of livestock. Poultry movement and droppings are very difficult to control and chickens freely roam in the compounds used by households and children. There is no practices (even means) of isolating sick birds from the household flocks and dead birds could sometimes be offered or left for either domestic or wild predators. Chickens and eggs are sold on open markets along with other food items and the current live bird marketing system displays significant and potential hazard to people (Demeke, 2008; Tadelle and Ogle, 2001).

2.1.2 Small Scale Modern Poultry Production System

In Ethiopia, the modern poultry production system is very small in size and confined to urban and pre-urban areas and contributes less than 2% of the total annual eggs and meat production of the country. In this system, exotic breeds are kept for operating on a more of commercial basis. Most small-scale poultry farms are located around Bishoftu town and Addis Ababa city. This production system is characterized by medium level of feed, water and veterinary service inputs and minimal to low bio-security. Most small-scale poultry farms obtain their feed and foundation stock from large-scale commercial farms (Nzietcheung, 2008).

They are also involved in the production and supply of table eggs to various supermarkets, kiosks and small roadside restaurants through middlemen. The small scale modern poultry farms located in Bishoftu and Addis Ababa enjoy the privilege of being advised and assisted by health professionals and Faculty of Veterinary Medicine of Addis Ababa University. They are also at the reach of information, vaccination and treatment drugs. The small scale modern poultry production systems located outside of these locations has limited access to such services. The small scale modern poultry farms could either be kept as supplementary to family income or as full time business (Demeke, 2008).

2.1.3 Large Scale Commercial Poultry Production System

This type of chicken production system use more inputs (feeds and feeding, breed, health, housing and other inputs) than the above two chicken production systems. The large-scale commercial production system is highly intensive production system kept under indoor conditions with a medium to high bio-security level. This system heavily depends on imported exotic breeds that require intensive inputs and modern management systems. It is estimated that this sector accounts for nearly 2% of the national poultry population. This system is characterized by higher level of productivity where poultry production is entirely market oriented to meet the large poultry demand in major cities. They should provide the expected product within that time. The existence of somehow better biosecurity practices has reduced chick mortality rates to merely 5% (Bush, 2006).The large scale commercial poultry Provide fertile eggs, table eggs, day old chicks, broiler meat and adult breeding stocks to the small scale modern poultry farms. They are kept as full time business and highly dependent on market for inputs. Formal marketing operations exist in urban and peri-urban areas practicing large scale commercial poultry production. The larger commercial poultry units have agreements with clients such as Ethiopian Airlines for using in the plane during transportation and the larger hotels to supply poultry meat and eggs. Most poultry meat is sold frozen. The majority of the products sold within the formal sector come from the commercial industry but a small number of frozen indigenous chickens are supplied through supermarkets in Addis Ababa (Demeke, 2008).

2.2 Production Performance of Poultry in Ethiopian

2.2.1 Production Performance of Indigenous Chicken

The poultry meat represents almost one-third of meat produced and consumed globally and the egg production, on a weight basis, is almost 80% that of poultry meat production (Scanes, 2007a). The basis for the increasing importance of poultry worldwide has been supported by the research on genetics, nutrition, disease control, and management (Havenstein *et al.,* 2007). The latest estimate of chicken population in Ethiopia is over 60 million out of which indigenous chicken comprises about 90%, the rest being the hybrid and exotic (CSA, 2017). Poultry production in the country plays a great role as a prime supplier of eggs and meat in rural and urban areas (Ojedapo *et al.,* 2008). Despite the fact that Ethiopia owns the largest indigenous chicken population in Africa, the annual egg and meat production of the country is disproportionally low. Full day scavenging indigenous chickens are usually capable of finding feeds for their maintenance requirement plus the production of few eggs (Tadelle and Ogle, 1996).The mean annual egg production of indigenous chickens is estimated at 40-60 small eggs with thick shells and a deep yellow yolk color (CSA, 2017). The carcass weight of local chickens at maturity varies from 1.045kg to 1.292kg for male and from 0.642kg to 0.874kg for female (Halima, 2007). Sexual maturity of local chicken as measured by age at first egg was reported to 169 days (Demeke, 2004, 2007).

The low productivity of the indigenous stock could also partially be attributed to the low management standard of the traditional production system. It has been seen that the provision of vaccination, improved feeding, clean water and night time enclosure improves the production performance of the indigenous chickens, but not to an economically acceptable level (Abebe, 1992). Local chickens are considered to be disease resistance and adapted to their scavenging environmental conditions. Unfortunately however, local chicken kept under intensive system of management (in confinement) are inferior to exotic stock in health status and characterized by lack of interest in their environment, wing droppings, huddling at the corner, leg weakness and cannibalism. They are also slow in rate of feathering and exhibit recurrent outbreak of diseases conditions (Demeke, 2004)

In the past, development initiatives of village poultry placed special emphasis on genetic improvement through the introduction of exotic breeds of chickens aimed at promoting small scale exotic poultry production within the rural farming population and up-grading of the indigenous chickens by crossing with exotic males (Alemu, 1987). Recently, there is a growing awareness of the need to balance the rate of genetic improvement with improvement in feed availability, health care and management. There is also an increased recognition of the potential of indigenous breeds and their role in converting locally available feed resources into sustainable production. Village poultry has the potential to satisfy the large segment of the current demand for poultry meat and eggs through better management of stock health and local feed resources. It would appear that simple changes in management practices are believed capable of bringing losses well below the reported high mortality and in turn improve the off take rate from traditional chicken farming (Demeke, 2004, 2007).

2.2.2 Production Performance of Exotic Chicken

Better production and productivity of poultry can be achieved with the application of inputs, better management, nutrition and disease prevention and control. Economically visible and sound poultry husbandry and management practices are keys towards developing improved poultry sector and optimize the production and productivity. Improvement in the management practices in the sector open the way for optimal expression of genetic potential of chicken in different production system and agro-ecology (EIAR, National Poultry Research Commodity

Strategy, 2016). The constraints for improving productivity are related to breeds unsuitable for the environment and to diseases, bad management, lack of supplementary feeding and predators. Successful poultry interventions would allow the subsector to move to improved family poultry with semi-scavenging crossbreds. Such a transformation would contribute considerably to reducing poverty and malnutrition among rural and urban poor, as well as increasing national income (ELMP, 2015).

The brooding stage performances of RIR Exotic breeds during brooding stage under improved management at Andasa Livestock Research Center indicates daily feed consumption (23g), daily body weight gain (3.6g) , actual body weights (137 g/chick), feed conversion ratio (6.5) and mortality rate (7.4%) respectively during 0-4weeks of brooding stage . From week 5-8 daily feed consumption (35g/day/chick), daily body weight gain (9.8 g/chic/day), feed conversion ratio (3.6) and mortality rate (1.8 %) was also reported for the same breeds in north Ethiopia (Hassen *et al.,* 2006).

Exotic breeds of chickens are reported to reach age at first egg at 4.7, 5.65, 5.13 months for white leghorn, Rode's Island red, and koekoek exotic chicken, respectively under farmer management condition in north Gonder (Adisu Getu, 2017). In east Showa zone Isa browon, Bova browon and koekoek exotic chicken breeds reach age at first egg at 5.35, 5.52, and 5.11months, respectively and also reach mature body weight 1.54, 1.55, 1.64kg under farmer management condition at maturity stage (Dasalewu, 2012). Exotic breeds of chickens are reported to produce about 250 eggs /year/ hen with around 60 g egg weights in Ethiopia (Alganesh *et al*., 2003). The maximum number of eggs/year/hen reported by the Ethiopian Institute of Agricultural Research from Fayoumi, Rhode Island Red and White Leghorn breed of chicken kept under intensive management system in north Ethiopia was 156, 185 and 176eggs, respectively (Lemlem and Tesfaye, 2010). Moreover, the average egg production per year per hen of exotic chicken of Rhode Island Red was 118.6 and 148.2 in lowland and highland agro ecological zone of central Tigray, respectively (Alem, 2014).

The laying cycle of flock of exotic chicken usually covers a span of about 12 months. Egg production begins when the birds reach about 18-22 weeks of age, depending on the breed and season. Flock production rises sharply and reaches a peak of about 90% after 6-8 weeks later. Production gradually declines to about 65% after 12 months of lay. There are many factors that can adversely affect egg production. Unraveling the cause of a sudden drop in egg production requires a thorough investigation into the history of the flock. Egg production can be affected by feed consumption (quality and quantity), water intake, intensity and duration of light received, parasite infestation, diseases, management and environmental factors (Jacob *et. al*., 1998).

Different authors reported the effect of breed on egg production and found no significant effect of breed on egg production (Duduyemi, 2005), while significant effect of breed on egg production and mortality rate are reported (Yakubu *et al.*, 2007). Moreover, significant effect of breed on age at peak egg production in a farm consisting of four strains of layers was reported (Gwaza and Egahi, 2009). The reported average egg production per clutch per hen of exotic chicken under the Ethiopian condition ranged between 38.5 and 45.2 in the lowland and highland agro ecological zone of central Tigray, respectively (Alem, 2014). Sexual maturity of White Leghorn chickens kept under intensive management system was reported to be 149days (Demeke, 2004, 2007). The egg weight of Fayoumi, Rhode Island Red and White Leghorn chicken kept under intensive condition of Adami Tulu Research center was 44.3, 52.5 and 43 g, respectively (Geleta *et al.*, 2013; Lemlem and Tesfaye, 2010). It was concluded that exotic breed and cross breed chicken produce larger number of eggs in the presence of adequate feed. Most results showed that the overall performance of the crosses was better than either the native or the exotic parents under the existing management condition (Aberra *et al*., 2005).

2.3. Egg Quality Traits

Quality has been defined as the properties of any given food that have an influence on the acceptance or rejection of this food by the consumer (Kramer, 1951). Egg quality is a general term which refers to several standards which define both internal and external quality. Egg quality is composed of those characteristics that affect its acceptability to consumers such as cleanliness, freshness, egg weight, shell quality; yolk index, albumen index, Haugh unit and chemical composition (Stadelman, 1977; Song et al., 2000). External quality is focused on egg shell cleanliness and thickness, egg weight, height, width and shape whereas internal quality refers to albumen cleanliness and viscosity, yolk quality and absence of blood spots

(Jacob et al., 2000; Kabir et al., 2014). The factors associated with the management and nutrition of the hen do play a role in internal egg quality, egg handling and storage practices do have a significant impact on the quality of the egg reaching the consumer (Kabir and Muhammad, 2011). It is obvious that beneficial egg quality traits are of immense importance to poultry breeding industries (Bain, 2005). In addition, embryonic development of hen's egg is dependent on traits like egg weight, yolk and albumen weights, genetic line and age of the hen (Onagbesan *et al.,* 2007).

The different strains of chickens vary in the different criteria of egg production and quality (Dolald *et al.,* 2002). Egg weight influences the weight of components of eggs especially egg albumen and yolk (Zhang *et al.*, 2005; Aygun and Yetisir, 2010). The relationship between weight, length and width of eggs has been reported by (Danilov, 2000) who also noted the proportion of yolk, albumen and shell that contribute to the egg weight increases with hen's age, reaching a plateau by the end of the laying cycle. Thus, egg weight is one of the important phenotypic traits that influence egg quality and reproductive fitness of the chicken parents (Islam *et al*., 2001; Farooq *et al*., 2001). Further, under smallholder farmers condition in northern Ethiopia, egg weight was recorded as 52.5g, 52.1g and 43 g for Rohde island Red, White leghorn and Fayoumi, respectively (Lemlem and Tesfaye, 2010). Hen age has also been shown to increase yolk weight (Van den Brand *et al.*, 2004) albumen weight (Suk and Park, 2001).

Yolk color is a key factor in any consumer survey relating to egg quality (Okeudo *et al.,* 2003). Consumer preferences for yolk color are highly subjective and vary widely from country to country. The determinant of yolk color is the xanthophyll (plant pigment) content of the diet consumed (Silverside *et al.*, 2001). Green grass during scavenging might be responsible for carotenoid deposits in the yolk, which improves the yolk color. Among feed ingredients, only supplemented maize contributes to improved color intensity of the yolk. Thus, if a hen has access to green grass or supplemented feed ingredients containing carotenoids/xanthophyll, it will be enough to give the yolk the color preferred by consumer (Zaman *et al*., 2004). Ethiopian consumers have a strong preference for eggs with deep yellow yolk color. Very small sized eggs from the scavenging local chicken with deep yellow yolk color fetch much higher prices compared to larger eggs of improved strains with pale yolk (Tadelle *et al.,* 2003a).

The Haugh Unit (HU) proposed by Haugh (1937), is calculated from the height of the inner thick albumen and the weight of an egg and it is considered to be a typical measure of albumen quality. It is generally accepted that the higher the Haugh unit value, the better the quality of the egg. It is also important that all eggs being evaluated at the same internal temperature. Age of the hen and season of the year can also affect Haugh unit values. Rajkumar *et al*. (2009) reported that brown egg layers produced eggs with higher HU. Research has shown in UK that there is consumer resistant to purchase eggs which have HU below 60, the actual HU figure where resistance to the product determined later by market researchers. Some of the large supermarkets chains in the United Kingdom set minimum acceptable level of 70 HU on regular documented tests (TSS, 1999).

The eggshell thickness is an important trait for hatchability. For best result of hatchability egg shell thickness should be between 0.33 and 0.35 mm and few eggs with a shell thickness less than 0.27mm will hatch (Khan *et al*., 2004). One of the main concerns is a decrease in eggshell quality as the hen ages, due to an increase in egg weight without an increase in the amount of calcium carbonate deposited in the shells. For this reason, the incidence of cracked eggs could even exceed 20% at the end of the laying period (Nys, 2001).The egg shell quality is given threw the weight and the percentage of shell thickness and the strength. The differences in eggshell quality depend on the environmental conditions, feed quality and strain of layers (Zita *et al.,* 2009). On the other hand no significant effect of breed on eggshell thickness under semi scavenging condition was reported (Khan *et al.,* 2004).

2.4 Performances of Dual Purpose Exotic Chickens

2.4.1 SassoT44 Breed of Chicken

Sasso is a commercial breed originating from France and being distributed to different regions of Ethiopia. The breed was tested for production performance, adaptability and live ability by smallholder farmers *(Fasil et al., 2016).*The SassoT44 Chicken stores or restaurants because it is naturally delicious and juicy. The taste is rich and succulent. From the wings meat and thighs to the breast meat it stay juicy long after cooking. It requires minimal preparation for a meal that won't soon be forgotten (info@watkinspoultry.com).

Age at the first egg lay or age at sexual maturity is an important trait in egg producing strains. According to the South Agricultural Research Institute, Areka Agricultural Research Center, SassoT44 breed performed well under farmer management condition. The average age at first egg was reported to be 4.76±0.85 months *(Aman et al., 2017)* compared to that of 5.35 ± 0.45, 5.52 ± 0.44 and 5.11± 0.2 months for Isa Brown, Bovans Brown and Potchefstroom Koekoek kept under village production system in East Shoa, respectively (Desalew, 2012). According to the South Agricultural Research Institute, Areka Agricultural Research Center, the average egg produced per hen per year by SassoT44 breeds kept under farmer management condition, was 229.14 ± 52.49 (Aman *et al*., 2017).The on-station growth performance of SassoT44 Breed kept at Debrezeite Agricultural Research center was33.0, 349.6, 703 and 829.6grams at an age of 0, 4, 7 and 8 weeks, respectively. Similarly, the on-station growth performance of SassoT44 kept at Haramaya was reported to be 42, 212.3 and 569.2g at an age of 0, 4 and 7weeks respectively (Assefa, 2016). According to the South Agricultural Research Institute, Areka Agricultural Research Center, the body weight of male and female of SassoT44 chicken at sexual maturity was 2.98 ± 0.70 and 2.73±0.53 kg at an age of 20 weeks (Aman *et al.*, 2017). In the north Gondar the age at firs egg was reported 4.7, 5.65, 5.13months for white leghorns, Rodes Island Red and Koekoek respectively (Adisu Getu, 2017) and in Tigray age at first egg for Isa brown, Bovan Browon, koekoek and Fayoumi exotic breeds was 8.16, 7.9, 7.7months, respectively (Lemlem and Tesfaye, 2010).

2.4.2 Potchefstroom Koekoek

Potchefstroom Koekoek was developed at the Potchefstroom Agricultural College during the 1950s in South Africa. This breed is a composite of White Leghorn, Black Australorp and Bared Plymouth Rock. The Potchefstroom Koekoek cocks and culled hens are used for meat production. The Koekoek's color pattern is attributed to a sex-linked gene used as means of color sexing in the process of cross-breeding for egg producing hens. The males inherit sex linked bar gene that are easily distinguished by having light grey bars on the feathers, while the females are darker (Van Marle-Koster and Nel, 2000).This breed is very popular among rural farmers in South Africa, and neighboring countries as dual purpose chickens capable of hatching their eggs. Potchefstroom Koekoek has been identified as tropically adapted and productive breed of chickens. It is one of the most promising breeds of chickens in terms of hen-housed egg production per hen and hatchability (Grobbelaar *et al.,* 2010). Age at first egg and egg weight of Koekoek chicken kept in Ada'a and Lume districts of East Shoa was 153.3±6 days and 48.84± 6.77g, respectively (Desalew, 2012). Koekoek kept in South African local condition started laying at an age of 130 days with an average egg weight of 55.7g (Nithimo, 2004). The average age at first egg recorded from Koekoek breed of chickens kept under farmers' management condition of Mana district of Jimma Zone was 220 days with average egg weight of 41.7g (Biratu and Haile, 2016).

According to Debrazeit Agricultural Research center, Potchefstroom Koekoek breed of chicken attained body weight of 31, 262.2, 570.3and 686.5g at an age of 0, 4, 7and 8weeks, respectively. Similarly, Potchefstroom Koekoek breed of chicken kept under on-station condition at Haramaya University attained body weight of 39.2, 155 and 426.3g at an age of 0,4, and 7 weeks, respectively (Asefa, 2016). Desalew (2012) reported 1.87kg for Potchefstroom Koekoek at an age of sexual maturity in East Showa. The average live body weight 1.5 and 1.1 kg was recorded at an age of 20 weeks from male and female Potchefstroom Koekoek breed of chicken kept under farmer's management condition, respectively in East Shoa (Desalew, 2012). Nthimo (2004) reported mean body weight of 1.7kg for Koekoek breed of chicken at an age of 26weeks, while Argaw and Mengistu (2011) reported mean body weight of 1.39 kg at an age 19 weeks from Koekoek breeds kept under intensive management system at Haramaya University. Mean live body weight of 1.04 and 1.01kg was reported from male and female breed of chicken at an age of 15 weeks from Koekoek breeds kept under intensive management system at Hawassa University (Benerjee *et al.,* 2013). In general the mean body weight at an age of 20 weeks, achieved by Koekoek breed of chickens kept under farmer's management condition was promising (Gatiso, *et al*., 2016). Mean egg weight of 48.84 ±6.77g and mean yolk heights and albumin heights of 17.84 mm and 5 .64±1.55mm was recorded for the breed, respectively. The yolk weight and albumin weights of the eggs of Potchefstroom Koekoek breed of chickens was 15.90 ±3.57and 25.54 ±3.94, respectively. The yolk color value was (10.79±1.98) and the average Haugh units were 76.57. The average eggshell thickness was reported to be 0.29±0.026mm for Potchefstroom Koekoek breed of chickens kept under farmer management condition in central Ethiopia East Shewa (Dasalew, 2012). Average egg weight of 55.7g and brown egg color was recorded from Potchefstroom Koekoek breed of chickens kept under intensive management system in South Africa (Ramsey *et al.,* 2000).

2.4.3 Dominant Red Barred

The history and tradition of laying chickens selection in Czechoslovakia commenced in1928. The first closed lines were produced in 1955 at the Dobrenice Research Station and characterized as "Dominant Red Barred". Dominant Red Barred was the result of crossing paternal fast feathering Barred Rhode Island Red stock with maternal slow feathering Rhode Island Red stock and made available via the sales and export of day old chicks. They are very popular and attractively colored layer suitable for small scale and free range production conditions. Dominant Red Barred breed is specialized classic egg type chickens with high body weight and good adaptability to different breeding and production conditions. It is reported to be adaptable to extensive, free range, backyards or rural village production systems. Dominant Red Barred chickens yield high quality carcass that could be processed for local delicacy. The breed was bred to be very productive both in egg laying and meat production and found to be an excellent choices for a dual purpose chicken. They are highly adapted to sub-optimal and harsh production conditions. The daily feed consumption of Dominant Red Barred was reported to be 12,19,24,28,34,39, 49 and 53g at an age of 1, 2, 3, 4, 5, 6,7 and 8 week respectively. The mean body weight of 80g, 150g, 270g, 355g, 440g, 560g, 680g and 715g was attained at an e age of week 1, 2, 3, 4, 5, 6, 7, and 8 respectively. Livability of 94-96% and live body weight of 1.5kg and 2.1kg was reported from female and male chickens of Dominant Red Barred, respectively at an age of 18 weeks. Mean 50% lay of an average egg weight of 61.5g was reached at an age of 23weeks. Yearly production was reported to be 259eggs /hen at company level (Milan, 2017). There is no report of production performance of DRB under Ethiopian condition until now.

3. MATERIALS AND METHODS

3.1 Description of the Study Area

This study was conducted in Homa District of West Wollega Zone of Oromia Regional State located at 501km west of Addis Ababa. Homa district is categorized as 95%Woyna Dega (Mid-altitude) and 5% Dega (High-altitude). The altitude of the study area ranges between 1700m and 1920m.a.s.l. The mean annual rainfall ranges from 1300 to 2000 mm and the main rainy season (June – August) is characterized by heavy rain fall. The mean annual temperature ranges between 18 and 32 ^{0}C *(HDA office, 2017). H*uman population of Homa district was estimated to be 49,885 inhabitants (HDAO, 2017). Its climatic condition is suitable for Livestock production. The current farming system of the district is crop- livestock mixed farming system largely comprising cash crops specially Coffee. Homa district is characterized by shortage of grazing land for large ruminant and seems to be rather favorable for small ruminant and poultry production. The livestock population of Homa district was 13629cattle, 9529sheep, 1421goat, 3235donkey, 33954 poultry (HDLFDO, 2017).

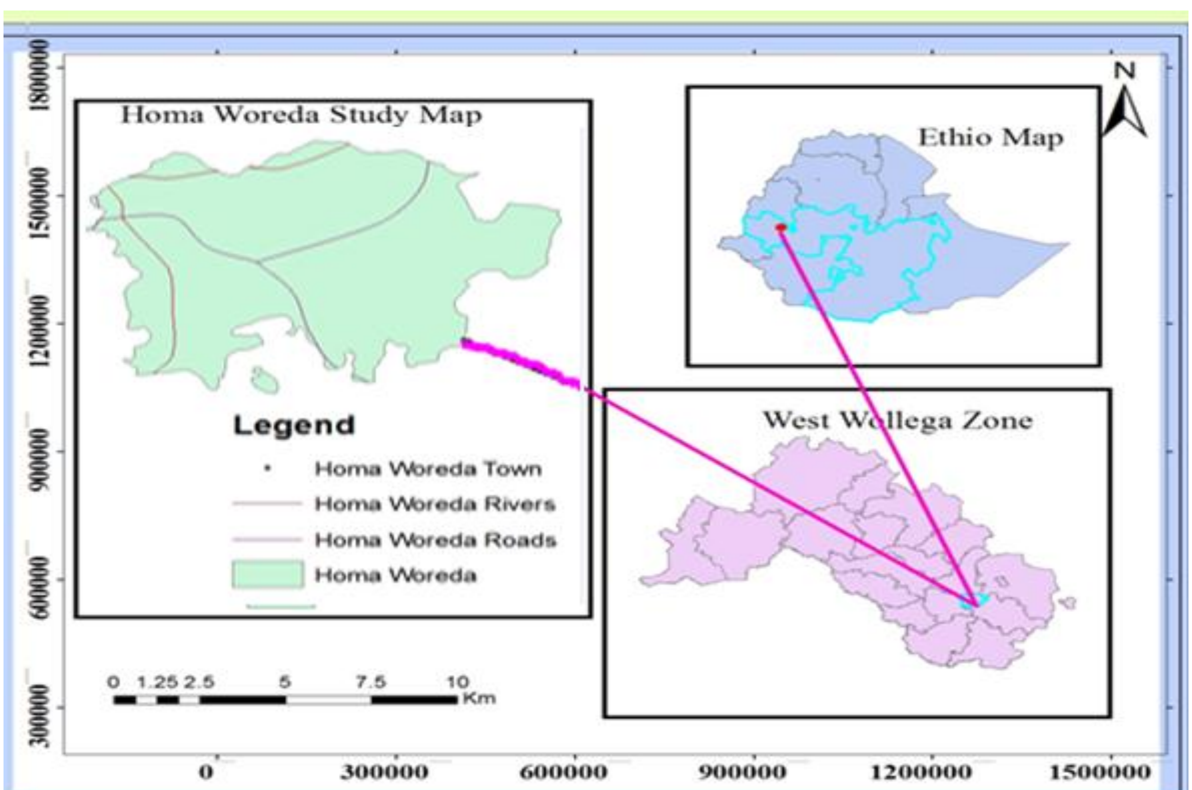

Figure1: Map of study area

3.2 On Station Management of Experimental Chicks

A total of 225 day old chicks (75 from each of SassoT44, Potchefstroom Koekoek and Dominant Red Barred dual purpose exotic chicken breed strains) and standard starter ration for experimental time of eight weeks were obtained from JUCAVM hatchery and transported to the experimental sites (Ali and Gashu private poultry farm). A group of 75 chickens was sub-divided into 3replications thus a total of 9 groups of day old chicks, each with 25 chicks and totally 225 chicks of comparable mean body weight were randomly assigned to 9 individual pens (electric brooder houses) in Completely Randomized Design (CRD) as shown in Table 1. The chicks were kept in 1.5 m x 1.5 m wire-mesh and wood partitioned deep litter floor (sawdust litter material) housing. Each pen was properly cleaned, disinfected, well ventilated, and electrically heated using 200 watt bulbs before the arrival of the chicks. All the groups were placed on standard starters ration, for experimental period of 8 weeks. Kwon amount of feed above the last day consumption was provided twice a day throughout the experimental period. The chicks were vaccinated against NCD, Coccidiosis, Fowl pox and Fowl typhoid. Clean water was ad libitum. Almost all equipment used for on station experiments were obtained from Ali and Gashu private poultry farm. From the first phase (brooding stage) feed consumption per chick per day, actual body weight and mortality were recorded while average daily gain (ADG) and feed conversion ratio (FCR) were calculated. The feed offered and refusal difference to the breeds determined feed consumption per chick per day; it was calculated from group consumption since the feed offered in group not individually. Average daily gain is the amount of weight gained per day for the bird over a given period of time. This was also calculated by taking group body weight and divided to the total numbers of chicks in that weeks since they eat in group not individually. Accordingly, ADG was obtained by dividing body weight gain with 57day because the initial weight was taken at 2nd day age of the birds, and the body weight gain was determined as the difference between the final and the initial weights taken during the experimental period on a sensitive scale. Feed conversion ratio was determined as the proportion of the weight of feed eaten by a bird per day to their ADG. The mortality was determined by recording birds that died during the experimental period.

Table1: Layout of the On-Station Experiment

Treatments (breeds)	Replication	No. Chicks/ Replication	Total No. of chicks
T1 (Breed of SassT44)	3	25	75
T2 (Breed of Potchefstroom Koekoek)	3	25	75
T3 (Breed of Dominant Red Barred)	3	25	75
Total	9	25	225

3.3 On- Farm Management of Experimental Birds

At the end of the 8 weeks of the brooding period, a total of 180 growers, 108 pullets and 72 cockerels (60 equal number from each of the three breed strains) were selected and each of the three groups of 60 growers was further sub-divided into 12 groups of growers, each with 5 growers (3 pullets plus 2 cockerels) totally 36 groups were adjusted. Thus each farmer was offered three groups of birds and total of 15 growers comprising 5 birds of each of the three breed strains for study period of 8 months in Homa district for comparative evaluation of the breed strains under farmer management condition (Table2). Basic training was given to the participating farmers regarding the managements of the experimental birds and data collection. All the participating farmers were advised to keep the birds under similar semi-scavenging condition (in terms of daily scavenging time) and daily supplementary times and levels. The farmers were providing with similar (composition) and similar amount of maize and homemade daily supplementary feed. The data recorded in second phase includes, body weight gain at grower and mature stages, age at onset of egg laying (AOEL), Daily egg production, mortality rate, sample egg for internal and external egg quality parameters were collected from all 12 households throughout the experimental period. Body weight gain was determined as the difference between the beginning and the end of the experimental period. Data on all egg production traits were collected daily from April 07/2018 for about 5 months separately for each three breed strains on a group basis from all participant farmers. The age at first egg within each of the breed strains was determined at 5% of flock egg lay.

Table 2: Layout of the On-farm Experiment

Treatments (breeds)	Replication/ Treatment	Growers/ Treatment	Total No. of growers
T1 (Breed of SasoT44)	12	5	60
T2 (Breed of Potchefstroom Koekoek)	12	5	60
T3 (Breed of Dominant Red Barred)	12	5	60
Total	**36**	**5**	**180**

3.3.1 Egg Quality Determination

A total of 72 eggs (Twenty four egg per breed strains) or two eggs per replication or household as (Table 3) was collected after two months of the first egg laid and stored at cooler room for a period of 4 days and transported to JUCAVM laboratory and used for the comparative evaluation of the internal and external egg qualities. In the determination of egg quality, each egg was individually weighed using sensitive balance, shell thickness, shell weight, egg yolk color, yolk index, albumen height, yolk weight, Egg shape index and Haugh Unit (HU) Score were used as egg quality measurement parameters. The shell thickness was measured at three region (large, middle and small end) using a micrometer gauge and the averages were used. Albumen height and yolk height were measured by tripod micrometer unit. Individual Haugh unit (HU) was calculated as: HU = 100log (AH - 1.7 $EW^{0.37}$ + 7.6), where HU = Haugh unit, AH = Albumen height and EW = Egg weight (Haugh, 1937). The egg shape index was calculated from egg width and length with the formula SI=W/L *100 (Anderson *et al.*, 2004). The yolk index was calculated from the width and heights of the yolk by formula YI= YH /YD *100 (Doyon *et al*., (1986), and the yolk color was measured with the use of Roche color fan (Haugh, 1937).The breaking strength was also measured with the use of Egg force Reader (06-UM-001 Version D) machine.

Table 3: Layout of the sample egg collected for Quality Determination Experiment

Treatments (breeds)	Replication/ Treatment	No. of Eggs/ Replication	Total No. of Eggs/Trt
T1 (Breed of SasoT44)	12	2	24
T2 (Breed of Potchefstroom Koekoek)	12	2	24
T3 (Breed of Dominant Red Barred)	12	2	24
Total	**36**	**2**	**72**

3.4 Statistical Analysis

All the data collected were entered in to Microsoft Excel and subjected to analysis of variance (ANOVA) by using Proc.GLM (General Linear Models) Procedure of Statistical Analysis System (SAS 9.3version). Least squares mean (LSM) were employed for mean comparisons and Tukey Honesty significant difference (HSD) test was used to separate the means. The confidential interval was set at 95% and for significant difference $\alpha = 5\%$.

The model statement was expressed as follows

$$Y_{ij} = \mu + A_i + e_{ij}$$

Where: Y_{ij} = an observation

μ = overall mean

A_i = fixed effect of breed strains. i = 3 (Sasso, Koekoek and Dominant Red Barred)

e_{ij} = random error

4. RESULTS AND DISCUSSION

This section describes the results of phases I and II; the first phase (on station brooding stage) included Feed consumption, mortality, ADG and FCR while Phase II (on farm under farmer management condition); describes BWG, AOEL, egg production traits, mortality and Internal and external egg quality parameters.

4.1 On- Station Brooding Performance

4.1.1 Feed consumption

The mean weekly feed consumption of the experimental chicks was shown in Table 4. Daily feed consumption of 12.73, 11.42 and 11.35 g/chick was attained by SassoT44, Koekoek and Dominant Red Barred breed strains of chicks during the first week of brooding. There was no significant difference (P>0.05) between Koekoek (11.47 g) and Dominant Red Barred (11.35g) breed strain of chicks during the first week of brooding. On the contrary, the mean daily feed consumption of SassoT44 (12.73g) was significantly (P<0.05) higher than the mean daily feed consumption of the other two breed strains. The result of this study was in agreement with the recommendation of the company of Dominant Red Barred which suggested 12 g/day/chick during the 1st week of brooding (Milan, 2017). The results obtained showed that there was no significant difference (P>0.05) among all the three breeds in mean daily feed consumption during the 2nd 4th and 7th weeks of brooding which was mean daily feed consumption of 20.2, 45.0 and 67.70 g/chick was recorded for all the three breed strains. This result was higher than that of the recommendation of the company for Dominant Red Barred, the value of which was 19, 28 and 39 g/chick/day at an age of 2, 4 and 7 weeks respectively (Milan, 2017). The variation might be attributed to the variation in feed composition; since they used mixtures of starter and grower ration starting from week 5 at company levels. As shown in Table 4, there was no statistically significant difference (P>0.05) between Koekoek and Dominant Red Barred breeds of chicks in mean daily feed consumption (42.1g/chick) during the entire brooding period. On the other side, the mean daily feed consumption of SassoT44 (45.75 g/chick) recorded during the entire brooding period was significantly (P<0.05) higher than that of the others. Such a better performance is could be attributed to the higher growth rate of sasoT44 than the others. The current result was comparable to that of Gezagn Tadese (2017), who reported 39.49 and 42.27 g/chick/day for Koekoek and Bovan Brown kept under intensive brooding management in South Wello Zone, respectively. Mean daily feed consumption of 80 g/chick was attained by Koekoek breed of chicks on the 8th week of brooding, the value of which was significantly higher (P<0.05) than that of Dominant Red Barred breed (70 g/h/d) but comparable to that of SassoT44 (77g/h/d). Thus the results of this study showed that SassoT44 were superior to Koekoek and Dominant Red Barred breed of chicks in mean daily feed consumption during the brooding stages (Table 4) which might be attributed to the genetic potential of SasoT44 since all the treatment groups were managed and kept under similar conditions.

Table 4: Mean daily feed consumption of the experimental chicks during the brooding period (g)

Parameters	Breed strains			SEM	P-values
	SS(N=75)	**KK(N=75)**	**DRB(=75)**		
Daily feed consumption during the 1st week	12.73[a]	11.47[b]	11.35[b]	0.211	0.0063
Daily feed consumption during the 2nd week	21.15	19.18	20.19	0.53	0.1053
Daily feed consumption during the 3rd week	35.58[a]	33.07[ba]	31.95[cb]	0.83	0.0524
Daily feed consumption during the 4th week	46.95	44.29	43.00	1.08	0.1013
Daily feed consumption during the 5th week	49.41[a]	43.74[b]	43.70[b]	0.91	0.0067
Daily feed consumption during the 6th week	64.67[a]	52.25[b]	60.74[ba]	2.08	0.0145
Daily feed consumption during the 7th week	70.40	67.13	65.58	1.16	0.0645
Daily feed consumption during the 8thweek	76.83[ba]	79.54[a]	70.24[b]	7.73	0.0338
Average Daily feed consumption	45.75[a]	42.12[b]	42.01[b]	0.48	0.0022

[a,b,c] Means between breed strains in the same row with different superscript letters are significantly ($p<0.05$) different; SS = SassoT44 ; KK = Koekoek , DRB = Dominant Red barred SEM= Standard error of mean

4.1.2 Body Weight Gain during Brooding Stage

The growth performances of the experimental chicks during brooding period were shown in Table 5. There was significant variation among all the three breeds of the experimental chicks in initial body weight which might be attributed to the difference in hatching weight. Mean body weight of 91.38, 74.26 and 76.21 g/chick was attained by SassoT44, Koekoek and Dominant Red Barred of chicks at the end of the first week of brooding, respectively. The result obtained showed that there was no significant difference (P>0.05) among the breed strains in growth performance during the first week of brooding (Table 5). Starting from the 3rd weeks of brooding the mean body weight attained by SassoT44 chicks was significantly (P<0.05) higher than the others. On the contrary, there was no significant difference (P>0.05) between Koekoek and Dominant Red Barred in growth performance up to the end of brooding. Similarly, mean body weight of 893, 739.66 and 631.92 g/chick was attained by SassoT44, Koekoek and Dominant Red Barred chicks on the 8th week of brooding, respectively, again this indicating that the mean body weight attained by SassoT44 breed of chicks during the entire brooding stage was significantly (P<0.05) higher than the others whereas there was no significant difference (P>0.05) between Koekoek and Dominant Red Barred chicks during brooding stage which might be attributed to the higher growth rate and feed consumption of SassoT44 breed of chicks during the brooding period.

The results of this study was comparable with the result of similar breed and age of the two experimental breeds studied (829 and 686 g) for SasoT44 and koekoek, respectively at the Debre Zeit Agricultural Research (Assefa, 2016). According to the result of the current study, SassoT44 had significantly (P<0.05) higher mean daily body weight gain (15.03g/d) than Koekoek (12.37g/head) and Dominant red barred (10.43g/head) which might be attributed to the genetic potential of SasoT44. The overall mean daily body weight gain (12.61g/chick) of all the three breed of chicks was higher than that of Rodes Island Red (8.4 g/head) and Fayoumi (4.1g/head) breeds of chicks reared in Central Oromia (Reta *et al.,* 2012). It is also higher than the reports of Haasen *et al.,* (2006) for RIR (9.8g) daily weight gain in north Ethiopia. The variation might be due to the difference in breed and management; they used hay box during brooding stages, and then that of Gezahegn (2017), who reported 8.24 and 6.93 g/chick/day for Koekoek and Bovan Brawon, respectively from the study conducted in South Wello Zone. The variation might be difference in breed and season. The mean live weight attained by Dominant Red Barred breed of chicks on the 8th week of brooding (631.92g/chick) was lower than the other two breed strains and the rate of growing performance suggested (715g/chick) by (Milan, 2017) which might be due to the difference in nutritional composition, since they used a mixtures of starter and grower ration starting from the 5th week of brooding. On the other side the mean body weight achieved by SasoT44 and

Koekoek breeds during brooding period showed good growth performance attributed to their genetic potential.

Table 5: Growth performance of the experimental chicks during brooding period (g/chick)

Parameters	Breed strains			SEM	P-values
	SS(N=75)	KK(N=75)	DRB(N=75)		
Initial body weight	35.82[b]	34.35[c]	37.21[a]	0.28	0.0001
Live body weight on the 1st week	91.38	74.26	76.21	5.07	0.1028
Body weight on the 2nd weeks	153.14[a]	108.63[b]	115.33[b]	6.39	0.0054
Body weight on the 3rd weeks	222.58[a]	158.89[b]	165.12[b]	9.31	0.0053
Body weight on the 4th weeks	322.37[a]	252.44[b]	241.57[b]	12.96	0.0009
Body weight on the 5th weeks	426.44[a]	322.13[b]	323.69[b]	11.34	0.0009
Body weight on the 6th weeks	527.78[a]	425.33[b]	385.72[b]	19.92	0.0060
Body weight on the 7th weeks	688.54[a]	576.13[b]	559.98[b]	23.77	0.0170
Body weight on the 8th week s	893.05[a]	739.66[b]	631.92[b]	34.08	0.0048

[a,b,c] Means between breed strains in the same row with different superscript letters are significantly ($p<0.05$) different; SS = SassoT44; KK = Koekoek , DRB = Dominant Red barred ,SEM= Standard error of mean.

Table6: Daily body weight gain of the experimental chicks during brooding period (g/chick)

Parameters	Breed strains			SEM	P -values
	SS(N=75)	KK(N=75)	DRB(N=75)		
Daily gain during the 1stweek	6.17	4.43	4.33	00.55	0.0969
Daily gain during the 2ndweeks	8.66[a]	5.34[b]	4.37[b]	0.57	0.0045
Daily gain during the 3rdweeks	9.92	7.14	7.11	0.96	0.1405
Daily gain during the 4thweeks	14.25	11.27	10.91	1.76	0.3976
Daily gain during the 5thweeks	14.87	12.05	11.73	1.06	0.1487
Daily gain during the 6thweeks	14.48[ab]	14.74[a]	8.86[b]	1.31	0.0325
Daily gain during the 7thweeks	19.63	18.21	16.66	1.40	0.385
Daily gain during the 8thweeks	21.50a	20.33a	14.27b	0.949	0.004
Mean daily gain during brooding	15.03[a]	12.37[b]	10.43[b]	0.595	0.005
Overall gain during brooding	857.24[a]	705.32[b]	594.71[b]	33.98	0.0046

[a,b,c]Means between breed strains in the same row with different superscript letters are significantly ($p<0.05$) different; SS = SassoT44; KK = Koekoek , DRB = Dominant Red barred SEM= Standard error of mean.

4.1.3 Feed Conversion Ratio

The results of the mean feed conversion ratio of the experimental chicks as measured by amount of feed required per unit body weight gain during brooding period was presented in Table 7. There was no significant (P >0.05) difference between SassoT44 (2.88) and Koekoek (3.04) breed strains of chicks in mean feed conversion ratio during the brooding period while mean feed conversion ratio of Dominant Red Barred (3.81) chicks was significantly (P<0.05) lower than the other. The results obtained indicated that SassoT44 and Koekoek breed strains of chicks had high feed conversion ratio and produced by lower cost than Dominant red barred breed strain. The mean feed conversion ratio calculated for all the three breeds of chicks in the current study (3.24) were higher than that recorded by Gezagn (2017), who reported mean feed conversion ratio of 5.25 and 6.17 for Koekoek and Bovan Brawn from the study conducted in South Wello Zone, the variation of which might be attributed to season and breed difference. The FCR of this study is agreed with the results of Hassen et al., (2006) 3.6 for RIR at Andasa Live stock research center.

Table7: Mean Feed Conversion Ratio of the Experimental Chicks during Brooding

Parameters	Breed strains			SEM	P-values
	SS(N=75)	**KK(N=75)**	**DRB(N=75)**		
Mean feed conversion ratio during 1st week	2.08	2.69	2.68	0.28	0.2823
Mean feed conversion ratio during 2nd weeks	2.46^{a}	3.69^{b}	4.63^{b}	0.24	0.0025
Mean feed conversion ratio during 3rd weeks	3.65	4.84	4.65	0.59	0.3783
Mean feed conversion ratio during 4th week	3.29	3.96	4.79	0.92	0.5547
Mean feed conversion ratio during 5th weeks	3.35	3.71	3.78	0.32	0.6393
Mean feed conversion ratio during 6th weeks	4.48	3.54	4.88	1.42	0.1421
Mean feed conversion ratio during 7th weeks	2.73	2.86	2.26	0.40	0.5858
Mean feed conversion ratio during 8th weeks	1.94a	3.41	5.54	1.11	0.1506
Overall feed conversion ratio during brooding	2.88^{a}	3.04^{a}	3.81^{b}	0.09	0.001

^{a,b,c} Means between breed strains in the same row with different superscript letters are significantly (p<0.05) different, SS = SassoT44, KK = Koekoek , DRB = Dominant Red barred SEM= Standard error

4.1.4 Mortality Rate during Brooding Stage

The result of mean percent mortality recorded from the current study is shown in Table 8. Mean percent mortality of 15.47, 14.95 and 13.28 % was recorded from SassoT44, Koekoek and Dominant Red Barred breed of chicks during the brooding period, respectively. There was no significant difference (P>0.05) among all the three breeds in percent mortality during the brooding period (Table8). The mean percent mortality calculated and recorded in the current study was higher than that of Koekoek (9.78%) and Bovan Brawn (2.89%) reported by Gezahegn (2017) and that of RIR (7.4) at Andasa Livestock research by Hassen et al.,(2006) which could be attributed to electrical power failure and the other.

Table 8: Mean percent mortality of the experimental chicks during brooding period

Parameters	Breed strains			SEM	P-values
	SS	KK	DRB		
Mean percent mortality during 1st week of brooding	8.52	10.00	7.93	2.17	0.7928
Mean percent mortality during 2nd week of brooding	2.66	4.94	5.34	2.18	0.6641
Mean percent mortality during 8th week of brooding	1.33	0.00	0.00	0.44	0.125
Mean percent mortality during brooding period	15.47	14.95	13.28	2.48	0.8145

^{a,b,c} Means between breed strains in the same row with different superscript letters are significantly (p<0.05) different; SS = SassoT44; KK = Koekoek , DRB = Dominant Red barred SEM= Standard error of mean.

4.2 Growth Performance during Grower Stage

The results of the body weights recorded from the pullets and cockerels of the three breed strains studied were shown in Table 9. The mean body weight of SassoT44 pullets at an age of 17 weeks (1.32 kg/head) was significantly higher (P<0.05) than that of Koekoek (1.18 Kg/head) and Dominant Red Barred (0.95 Kg/head). The results obtained showed that Dominant Red Barred pullets had significantly lower mean body weight than the others at an age of 16 weeks which might be attributed to the low genetic potential of Dominant Red Barred. There was no statistically significant (P>0.05) difference between the cockerels of SasoT44 (1.42 kg/head) and Koekoek (1.35kg/head) in mean body weight at an age of 17 weeks, while the cockerels of Dominant Red Barred (0.98kg/head) had significantly (P< 0.05) lower mean body weight than the others. The mean body weight of Dominant Red Barred obtained in the current study was also lower than that reported (2.1 Kg/head for males and 1.5 kg/head for females) by Milan (2017) under intensive management; the variation of which might be due to the difference in management condition. The results of the current study also showed that there was no statistically significant (P>0.05) difference between the pullets of SasoT44 (8.61g) and Koekoek (8.78g) in mean daily body weight gain while the pullets of Dominant Red Barred (7.00g) had significantly (P< 0.05) lower mean daily body weight gain than the others. According to the results of this study, the mean body weight of Koekoek pullets (1.18kg) at an age of 17 weeks was almost similar with that of both Koekoek pullets 1.01 and cockerels 1.04 Kg/head from trial conducted in Hawasa University at an age of 15 weeks (Benerjee *et al.*, 2013). According to the results of the current study, the mean body weight achieved by SasoT44 (1.37kg) and Koekoek (1.27kg) at an age of 16weeks under farmer's management condition seems to be promising which might be attributed to the difference in genetic potential of both breeds in adapting and producing better under farmer management, while Dominant Red Barred had relatively poor performance.

Table 9: Performance of the Experimental chicken during the grower stage (week17)

Parameters	Breed strains			SEM	P-values
	SS	KK	DRB		
Females(pullets)					
Mean initial body weight (kg/head)	0.846[a]	0.697[b]	0.565[b]	26.10	0.0001
Mean final body weight(kg/head)	1.32[a]	1.18[b]	0.95[c]	0.05	0.0001
Overall body gain	474 [b]	483 [a]	385 [c]	2.05	0.0001
Mean daily body weight gain(g/head)	7.52[a]	7.66[a]	6.11[b]	0.51	0.0001
Mean mortality during the growing period (%)	38.88[ba]	27.77[b]	47.22[a]	5.36	0.0490
Males (cockerels)					
Mean initial body weight (kg/head)	0.940[a]	0.782[b]	0.697[c]	23.05	0.0001
Mean final body weight(kg/head)	1.42[a]	1.35[a]	0.98[b]	0.14	0.0001
Overall body gain	480 [b]	568 [a]	283 [c]	19.30	0.0006
Mean daily body weight gain(g/head)	7.61[a]	9.01[a]	4.49[b]	0.87	0.0001
Mean mortality during the growing period (%)	16.66	20.83	25.00	7.36	0.7281
Over all mean for the breed strains					
Mean initial body weight (kg/head)	0.893[a]	0.739[b]	0.631[b]	18.60	0.0001
Mean final body weight(kg/head)	1.37[a]	1.27[a]	0.96[b]	0.08	0.0001
Overall body gain(g/head)	477 [b]	531 [a]	329 [c]	1.56	0.0001
Mean daily body weight gain(g/head)	7.57[a]	8.42[a]	5.22[b]	0.52	0.0001
Mean mortality during the growing period (%)	30.00	25.00	38.33	4.04	0.0767

[a,b,c] Means between breed strains in the same row with different superscript letters are significantly (p<0.05) different; SS = SassoT44; KK = Koekoek , DRB = Dominant Red barred SEM= Standard error

4.3 Mortality Rate during Grower stage

The percent mortality recorded from this study during the growing period of 9-17 weeks is shown in Table 9. As shown in Table 9, percent mortality of 25, 30 and 38.33 % was recorded from Koekoek, SassoT44 and Dominant Red Barred, respectively. The higher percent mortality recorded from this study during the growing period was attributed to the outbreak of coccidiosis and absence of medication in the study district soon after the outbreak and the nutritional stress caused by switching off from commercial ration to scavenging and homemade supplementary ration during growing period. The percent mortality recorded for Dominant Red Barred growers is contrary to that of Milan (2017) who suggested that Dominant Red Barred strain is highly adapted to sub optimal and harsh production condition. The mean percent mortality obtained in the current study was also not in conformity with the result of Demeke (2004) who reported 5 and 7 % mortality for local and White Leghorn exotic growers kept under scavenging systems, respectively. In Ethiopia up to 49% mortality in village chickens were reported. The causes of morality mainly attributed to Newcastle disease and nutritional stress (Tadelle *et al.,* 2003; Gueye 1998; Chitate and Guta, 2001). Comparable percent mortality of 22.2 and 39.5 % was reported from Potchefstroom Koekoek and White Leghorn kept under controlled environment in South Africa (Grobbelaar *et al.,* 2010). SasoT44 and Koekoek chickens performed well in body weight gain while Dominant Red Barred breeds kept under the same management system was found to be inferior to the others which might be attributed to the difference in scavenging ability and adaptability to local environment. The results of this study was in agreement with the reports of Demeke (2004) that indicated the introduced exotic chickens into rural household conditions in Ethiopia are subjected to considerable hazards of diseases, parasites and predators

4.4 Performance during Laying Period (mature stage)

4.4.1 Body Weight Gain

The performances of the experimental chicken during the early laying periods were shown in Table10. The overall mean body weight of SasoT44 (2.40 Kg/head) and (Koekoek (1.90kg) breed strains were significantly ($P < 0.05$) higher than Dominant Red Barred (1.33kg) at an age of 24 weeks. There was no statistically significant (P>0.05) difference between SasoT44 (2.48kg/head) and Koekoek (2.03kg/head) in mean body weight of cockerels at an age of 22 weeks. On the other side the mean body weight of cockerels of Dominant red Barred (1.47kg/head) to an age of 22 weeks was significantly P< 0.05) lower than the others. The mean body weight of pullets of SasoT44 (2.31kg/head) was significantly (P< 0.05) higher than the pullets of the koekoek (1.76kg) and Dominant Red barred (1.28kg). The results of this study was higher than the mean body weight recorded from both females and males (1.03 and 1.34 Kg/head) of Koekoek growers kept under farmer management condition during the first twenty weeks of age in Mana districts of Jimma Zone (Biratu and Haile, 2016) which might be attributed to the difference in management during brooding period that used hay box brooder under farmer's management conditions. The overall mature weight obtained in the present study also higher than the mean body weight of mature Isa brown, Bovan Brown and Koekoek exotic breeds 1.54kg, 1.55kg and 1.64 Kg/head, respectively kept under village production system in east Showa of Oromia regional state (Desalew, 2012) which might be due to the difference in genotypes and farmer's management conditions. Based on the results of this study, Dominant Red Barred layers were poorly adapted when kept under farmer's management as compared to SasoT44 and Koekoek exotic chickens, while SasoT44 and Koekoek layers achieved better growth performance than Dominant Red Barred, which might be attributed to the difference in genetic potential of both breeds. The results obtained from Koekoek breed of chicken in the current study was in agreement with that of (Grobbelaar *et al.,* 2010), who suggested that Koekoek breed of chicken are adapted and productive in the tropics.

Table 10: Performance of the Experimental pullets & cockerels during the maturity stages

Parameters	Breed strains			SEM	P-values
	SS(N=60)	KK(N=60)	DRB(N=60)		
Females(pullets)					
Mean initial body weight (kg/head)	1.32^a	1.18^b	0.95^c	0.05	0.0001
Mean final body weight(kg/head)	2.31^a	1.76^b	1.20^c	0.08	0.0001
Overall body gain	990^a	580^b	250^c	2.88	0.0001
Mean daily body weight gain(g/head)	19.03^a	10.54^b	4.80^c	0.51	0.0001
Age at firs egg laying (days)	157.58^a	163.66^b	181.33^c	1.26	0.0001
Mean daily egg production /5months/hen	0.60^a	0.59^a	0.42^b	1.08	0.0001
Males (cockerels)					
Mean initial body weight (kg/head)	1.42^a	1.35^a	0.98^b	0.14	0.0001
Mean final body weight(kg/head)	2.48^a	2.03^a	1.47^b	0.14	0.0001
Overall body gain	1060^a	680^b	490^c	2.88	0.0001
Mean daily body weight gain(g/head)	20.38^a	13.07^b	9.42^c	0.87	0.0034
Age at sexual maturity(days)	168^a	166^a	197^b	5.43	0.0001
Over all mean for the breed strains					
Mean initial body weight (kg/head)	1.37^a	1.27^a	0.96^b	0.08	0.0001
Mean final body weight(kg/head)	2.40^a	1.90^b	1.33^c	0.08	0.0001
Overall body gain	1025^a	625^b	370^c	2.88	0.0001
Mean daily body weight gain(g/head)	19.80^a	12.11^b	7.11^c	0.52	0.0001

[a,b,c] Means between breed strains in the same row with different superscript letters are significantly ($p<0.05$) different; SS = SassoT44; KK = Koekoek , DRB = Dominant Red barred SEM= Standard error of mean

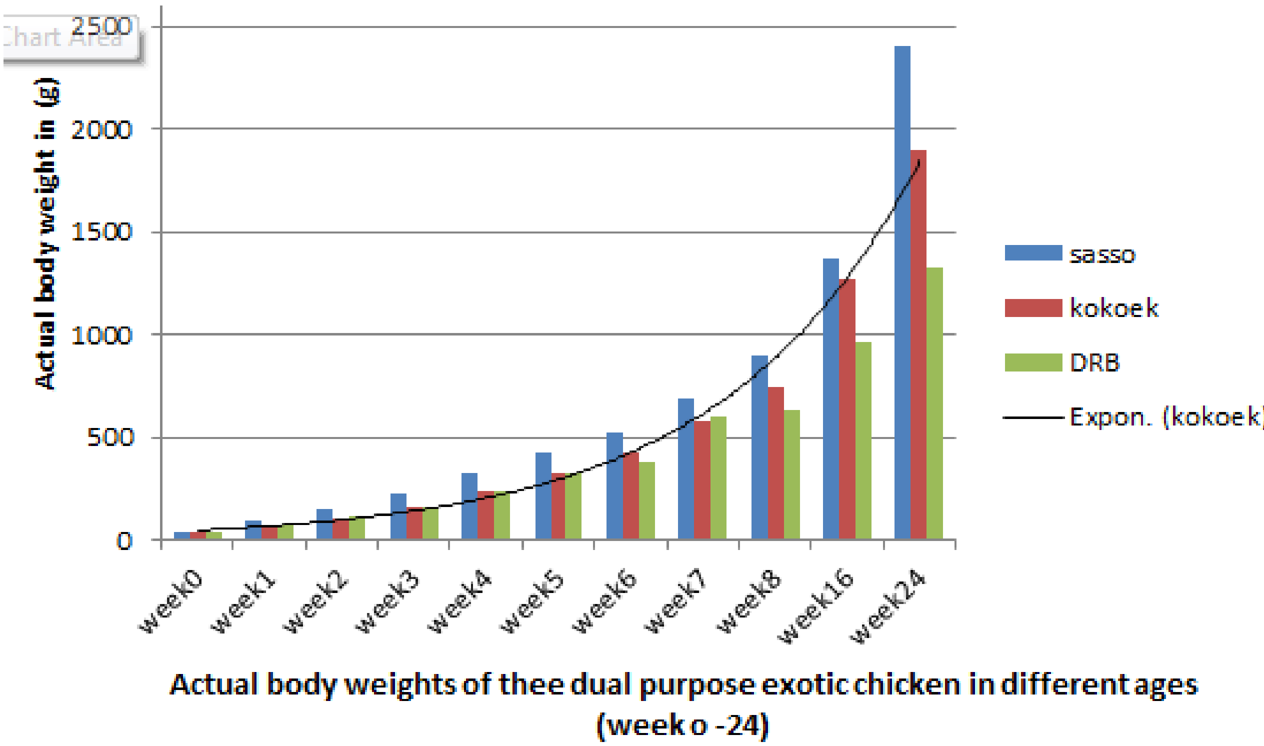

Figure2: Body weights of Experimental chickens from week 0 to 24

4.4.2 Ages at First Egg

The mean age at first egg lying of the three dual purpose breed strains studied were presented in Table 10. The mean age at first egg was 158, 164 and 181 days for SasoT44, Koekoek and Dominant Red Barred pullets, respectively. The results obtained indicated that SasoT44 pullets reached age at onset of egg laying significantly ($P<0.05$) earlier time under farmers management than the others. Moreover, Koekoek pullets kept under farmers management reached age at onset of egg laying significantly ($P<0.05$) earlier time than Dominant Red Barred. The results of this study were in agreement with that of Desalew (2012) who reported mean age at first egg of 153, 160 and 165 days for Potchefstroom Koekoek, Isa Brown and Bovans Brown kept under village production system in East Showa, respectively. The difference between the three breeds in mean age at first egg might be attributed to the difference in genetic potential and ability to adapt to the local environment.

4.4.3 Egg Production

The mean egg production performances of the three breed strains studied were shown in Table 10. Mean daily egg production of 0.60, 0.59 and 0.42 egg was recorded for SasoT44, Koekoek and Dominant Red Barred, respectively during the first five months of laying. There was no significant difference (P>0.05) between SasoT44 and Koekoek layers in mean daily egg production. On the contrary the mean daily egg production recorded during the first five months of laying from Dominant Red Barred was significantly (P<0.05) lower than the others which might be attributed to the poor scavenging ability of Dominant Red Barred compared to the others. The results of this study was in agreement with that of Aman *et al*., (2017) who reported 0.63eggs/day for SassoT44 layers kept under local condition in Wolaita Zone of SNNP regional state. The results of the current study was higher than that of Adisu *et al.*, (2017), who reported 0.30, 0.27 and 0.38 eggs/day for Rodes Island Red , Koekoek and White Leghorn kept under local condition in north Gonder respectively. The difference between the results in the egg mass obtained in this study could be due to the factors such as egg production period, farmer management condition and breed type. The result of mean daily egg production recorded for Koekoek layers in the current study was in agreement with the report of Grobbelaar (2010), who suggested that, Koekoek breed of layer is one of the promising breed of chicken in terms of hen house egg production under the local condition of the tropics. The result of the mean daily egg production obtained from Dominant Red Barred breed in the current study was contrary to that of Milan (2017) who suggested that Dominant Red Barred layers are very productive both in egg laying and meat production and found to be an excellent choices for dual-purpose chicken under sub optimal and harsh production condition the difference of which might be attributed to variation in management.

4.3.5 Egg Quality Characteristics

The egg quality characteristics of the three breed strains were presented in Table 11. The results obtained indicated that there was no significant (p>0.05) difference between SasoT44 (51.63g) and Koekoek (51.40g) in mean egg weight both of which had mean egg weight that are significantly (P<0.05) higher than that of Dominant Red Barred (47.45g). The mean egg weight recorded for SasoT44 and Koekoek eggs was in agreement with that of Fasil *et al*., (2016), who reported mean egg weight of 51.6g /egg for Koekoek layers kept at Debre Zeit Agricultural Research Center. On the other side the mean egg weight reported by Desalew (2012), for Koekoek layers (48.84g) from the study conducted in East Showa was lower than that reported in the current study. There was no significant difference (P>0.05) among all the three breed strains studied in egg shape index, the values of which were within the standard and ranged between 73 and 76 %. The egg shape index recorded in the current study was lower than that of Niraj Kumar *et al.* (2014), who reported egg shape index of 77.28 and 78.43 for Rodes Island red and Bovan White kept under intensive management in North Ethiopia, respectively which might be attributed to difference in genotypes. The mean egg shell weight recorded for Dominant Red Barred (5.65g) was significantly (p<0.05) lower than the others while there was no significant (P>0.05) difference between Koekoek (6.17g) and SasoT44 (5.85g) in mean egg shell weight. These results were higher than that reported by Niraj Kumar *et a.l* (2014), who recorded 5.20 and 5.03 g for Rodes Island Red and Bovan White kept under intensive management in north Ethiopia which might be attributed to difference in management and genotypes. There was no significant (P>0.05) difference between all the three breeds in shell thickness. The albumen weight of Dominant Red Barred (26.40g) was lower than that of SasoT44 (29.27g) and Koekoek (29.72g). There was no significant (P>0.05) difference between SasoT44 and Koekoek eggs in mean albumen weight. These results were lower than that of Desalew (2012) who reported mean albumen weight of 33.37 and 34.54 g for Isa Brown and Bovan Brown from the study conducted in East Showa under farmer management condition which might be attributed to difference in ages and genotypes of the laying hens. There was no significant (P>0.05) difference between SasoT44 (16.77mm) and Koekoek (16.47mm) in mean yolk height, while Dominant Red Barred(15.86mm) had significantly(P<0.05) difference lower mean yolk height than that of others. The results of the current study was lower than that of Desalew (2012), who reported 17.41, 17.84 and 17.84 mm of mean yolk height for Isa Brown, Bovan Brown and Koekoek from trials conducted in East Showa under farmer management condition which might be attributed to difference in ages and genotypes of the laying hens. The yolk colors of Koekoek (7.20) was significantly higher (P<0.05) than that of SasoT44 (6.25) and Dominant Red Barred (5.54). There was no significant difference between SasoT44 and Dominant Red Barred in yolk color (P>0.05) which could be attributed to the availability of green plant material in the study area. Desalew (2012) reported yolk color of 9.94, 7.77 and 10.79 for Isa Brown , Bovan Brown and Koekoek exotic breeds kept under village production system in East Showa Zone. There were no significance (p>0.05) difference among SasoT44 (76.74), Koekoek (75.49) and Dominant Red Barred (75.46) in HU scores. The results of HU obtained from the current study was in agreement with that of Desalew (2012) who reported 77.7 and 76.56 for Isa brown and Koekoek kept under village production system in east Showa Zone. Age of the hen and season of the year affects HU. According to the United States Department of Agriculture, eggs with Haugh Unit score of above 72.00 is classified as grade AA, while there is consumer resistant to purchase eggs which have HU below 60. The height of the thick albumen surrounding the yolk, combined with the egg weight, determines the Haugh Unit score. The higher the HU, the better the egg quality (Haugh, 1937). Thus, the qualities of all the eggs produced by all the three breed strains studied were within acceptable range as measured by HU-score. The general tendency indicated that, based on the overall internal and external egg quality parameters, all the three breeds were equally productive under the local farmer's management conditions.

Table 11: Egg quality traits of Experimental chickens in Homa district

Parameters	Breed strains			SEM	P-values
	SS (N=24)	KK(N=24)	DRB(N=24)		
External egg quality					
Egg weight (g)	51.63^{a}	51.40^{a}	47.45^{b}	0.77	0.0003
Breaking strength(Kg/cm^2	2.99	3.10	3.39	0.143	0.1278
Egg shape index (%)	75.56	74.80	76.23	0.65	0.3038
Shell thickness (mm)	0.35	0.36	0.37	0.009	0.4388
Shell weight(g)	5.85^{ba}	6.17^{a}	5.65^{b}	0.146	0.0431
Internal egg quality					
Albumen height (mm)	5.70	5.56	5.25	0.246	0.4140
Albumen weight (g)	29.27^{a}	29.72^{a}	26.40^{b}	0.611	0.0004
Yolk height (mm)	16.47^{a}	16.77^{a}	15.86^{b}	0.192	0.0024
Yolk weight (g)	16.45	15.04	15.39	0.337	0.0560
Yolk color (1-15)	6.25^{b}	7.20^{a}	5.54^{b}	0.262	0.0001
Yolk Index (%)	49.69	51.48	51.12	1.05	0.449
Haugh Unit (HU)	76.74	75.49	75.46	1.80	0.850

^{a,b,c} Means between breed strains in the same row with different superscript letters are significantly ($p<0.05$) different; SS = Sasso T44; KK = Koekoek , DRB = Dominant Red barred SEM= Standard error of mean.

5. SUMMERY, CONCLUSIONS AND RECOMMENDATIONS

This study was conducted in Homa district of west Wollega zone to evaluate performance of three dual purpose Exotic Chicken strains for on station during brooding stages and under farmer management conditions during grower and mature stages. Based on, the results of Phase I (brooding period) indicated that feed consumption, growth rate and FCR were significantly ($p<0.05$) higher for SasoT44. The results of phase II (growing and laying periods under farmer management condition) the both SasoT44 and Koekoek breeds of chickens showed good production potential under farmers' management condition in terms of body weight gain, age at first egg and daily egg production which might be attributed to their better genetic potential. There was no significant difference in many of the internal and external egg quality parameters among all the three breed strains of chicken kept under farmers' management conditions. Dominant Red barred breed strain of chicken were less adapted to the farmer management conditions compared to SasoT44 and Koekoek breeds of chickens. This SasoT44 and Koekoek exotic breed have good acceptance in terms of their body weight, egg quality, adaptability to wide climatic conditions, feeding behavior and their color which has a market value. Therefore, this both breed strains are suitable and recommended for scavenging and semi-scavenging chicken production system.

Recommendations

- Further study is recommended for growth and production performance under intensive production system in the districts.
- Further study for full live egg production study is recommended in the districts.
- Disease and Lack of commercial feed is still series problem in the district so it is very important to take care to reduce risks by vaccination and biosecurity.
- Further experimental work is recommended in the area of studying meat quality and reproductive performance of these breeds before large scale introductions.

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7. APPENDEX

Appendix1: ANOVA Table for daily feed consumption through brooding stages

Parameters	Sum of Squares	Df	Mean Square	F	Sig.
Week1 daily feed consumption Between Group	3.514	2	1.757	13.201	0.006
Week2 daily feed consumption Between Group	5.803	2	2.901	3.354	0.105
Week3 daily feed consumption Between Group	20.731	2	10.366	5.016	0.052
Week4 daily feed consumption Between Group	24.272	2	12.136	3.435	0.101
Week5 daily feed consumption Between Group	64.603	2	32.301	12.945	0.007
Week6 daily feed consumption Between Group	241.999	2	121.000	9.292	0.015
Week7 daily feed consumption Between Group	36.297	2	18.148	4.479	0.065
Week8 daily feed consumption Between Group	137.316	2	68.658	6.277	0.034
Average daily feed consumption Between Group	27.200	2	13.600	19.947	0.002

Appendix 2: ANOVA Table for Body weight through brooding stages

Parameters	Sum of Squares	df	Mean Square	F	Sig.
Day old Body weight between groups	12.273	2	6.136	24.604	0.01
Week1 Body Weight Between Groups	526.899	2	263.449	3.404	0.103
Week 2 Body Weight Between Groups	3456.041	2	1728.021	14.071	0.005
Week3 Body Weight Between Groups	7397.005	2	3698.503	14.234	0.005
Week4 Body Weight Between Groups	11536.608	2	5768.304	11.431	0.009
Week5 Body Weight Between Groups	21439.866	2	10719.933	27.776	0.001
Week6 Body Weight Between Groups	32245.998	2	16122.999	13.540	0.006
Week7 Body Weight Between Groups	29425.469	2	14712.734	8.675	0.017
Week8 Body Weight Between Groups	103327.736	2	51663.868	14.825	0.005

Appendix 3: ANOVA Table for Body weight gain through brooding stages

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Breed	Daily Body Weight Gains week1	6.388	2	3.200	3.588	0.097
	Daily Body Weight Gains week2	30.418	2	15.209	15.160	0.005
	Daily Body Weight Gains week3	15.388	2	7.695	2.756	0.142
	Daily Body Weight Gains week4	20.158	2	10.079	1.080	0.398
	Daily Body Weight Gains week5	17.891	2	8.946	2.663	0.149
	Daily Body Weight Gains week6	66.232	2	33.116	6.400	0.033
	Daily Body Weight Gains week7	13.238	2	6.619	1.125	0.385
	Daily Body Weight Gains week8	90.398	2	45.199	16.716	0.040
	Overall mean Body Weight Gains	32.048	2	16.024	15.088	0.005

Appendix 4: ANOVA Table for daily feed Conversion through brooding stages

Parameters	Sum of Squares	df	Mean Square	F	Sig.
Week1 daily feed conversion ratio Between Group	0.740	2	0.370	1.573	0.282
Week2 daily feed conversion ratio Between Group	7.107	2	3.554	19.075	0.003
Week3 daily feed conversion ratio Between Group	2.458	2	1.229	1.148	0.378
Week4 daily feed conversion ratio Between Group	3.373	2	1.687	0.651	0.555
Week5 daily feed conversion ratio Between Group	0.314	2	0.157	0.483	0.639
Week6 daily feed conversion ratio Between Group	2.847	2	1.424	4.123	0.075
Week7 daily feed conversion ratio Between Group	0.586	2	0.293	0.585	0.586
Week8 daily feed conversion ratio Between Group	19.658	2	9.829	2.639	0.151
Average daily feed conversion ratio Between Group	1.492	2	0.746	29.07	0.001

Appendix 5: ANOVA Table for Mortality Rate through brooding stages

Parameters	Sum of Squares	Df	Mean Square	F	Sig.
Week1 mortality rate % Between Group	6.829	2	3.415	0.241	0.793
Week2 mortality rate % Between Group	12.508	2	6.254	0.438	0.664
Week8 mortality rate % Between Group	3.538	2	1.769	3	0.125
Total mortality rate% Between Group	7.873	2	3.937	0.212	0.815

Appendix 6: ANOVA Table for Grower stage performance

Source	Sum of Squares	df	Mean Square	F	Sig.
Week16 Male Body Weight between Groups	2.252	2	1.126	19.015	0.000
Week16 female Body Weight between Groups	1.401	2	0.701	11.111	0.000
Week16Overall Body Weight Between Groups	3.549	2	1.775	27.924	0.000
Week16Male mortality rate between Groups	416.667	2	208.333	0.320	0.728
Week16 Female mortality rate between Groups	2284.049	2	1142.025	3.308	0.049
Week16Overall mortality rate between Groups	1767.108	2	883.554	1.561	0.217

Appendix 7: ANOVA Table for mature stages performance

Source	Sum of Squares	Df	Mean Square	F	Sig.
Week22 Male Body Weight Between Groups	6.103	2	3.052	12.249	0.000
Week22 female Body Weight Between Groups	7.505	2	3.752	44.592	0.000
Week22 Overall Body Weight Between Groups	13.562	2	6.781	38.833	0.000
Week22 Male Daily Body Weight gain Between Groups	125.581	2	62.791	6.782	0.003
Week22 Female Daily Body Weight gain Between Groups	164.001	2	82.000	26.191	0.000
Week22 Overall Daily Body Weight gain Between Groups	287.901	2	143.951	22.177	0.000
Week22 Male mortality rate Between Groups	416.667	2	208.333	0.320	0.728
Week22 Female mortality rate Between Groups	2284.049	2	1142.025	3.308	0.049
Week22 Overall mortality rate Between Groups	1767.108	2	883.554	1.561	0.217

Appendix 8: ANOVA Table for Egg quality parameters

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Breeds	EW	264.716	2	132.358	9.294	0.000
	BS	2.082	2	1.041	2.120	0.128
	AH	2.592	2	1.296	.893	0.414
	YH	11.701	2	5.851	6.604	0.002
	YC	33.583	2	16.792	10.126	0.000
	AW	155.114	2	77.557	8.637	0.000
	YW	16.409	2	8.204	3.007	0.056
	SW	3.370	2	1.685	3.293	0.043
	ST	.004	2	.002	.834	0.439
	SI	78.679	2	39.340	3.550	0.034
	HU	25.536	2	12.768	.163	0.850
	YI	3.671	2	1.835	.081	0.923

Appendix 9: ANOVA Table for Egg production parameters

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model		5135.722[a]	2	2567.861	181.779	0.000
Intercept	Egg production	235872.111	1	235872.111	1.670E4	0.000
Breeds		5135.722	2	2567.861	181.779	0.000

Figures3: Different pictures during the experimental works

Fig.3.1 On station Experimental units in their replication

Fig 3.3 Photo during Supervision at experimental site

Fig 3.4 Photo during egg quality test in lab