Sudan University of Science and Technology

College of Graduate Studies

Comparison between Four Commercial Broiler Breeds in Production Performance and Carcass Characteristics under Sudan Condition

مقارنة بين أربعه سلالات دجاج لاحم تجارية في الأداء الانتاجي وخصائص الذبيحة تحت ظروف السودان

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بسم الله الرحمن الرحيم

"قَالُواْ سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ"

سورة البقرة الأية32

Dedication

To those who cannot for the words that died their right

To my dear Father and dear Mother

To my dears brothers and dears sisters

To my dears friends

To both fell out of my pen inadvertently

I dedicate this work

Acknowledgements

Praise be to God, who enlightened us to the path of science and knowledge and helped us to perform this duty and grant us to accomplish this work

Our sincere thanks and gratitude to all who has helped us, from near or from afar on the completion of this work and in overcoming the difficulties we faced, and singled out the supervising Dr. Salaheldin Sidahmed Ahmed, which he gave me his advice and directives value that was help me in the completion of this research.

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And I cannot fail to thank all My family

Abstract

An experiment was carried out to study the performance and carcass characters of four commercial broiler breeds Arbor Acer, Cobb, Hubbard and Ross at department of Animal production , College of Agricultural Studies, Sudan University of Science and Technology, in Poultry Farm during the period from5 December2015 and ending on 9January2016 (35days). which the ambient temperature ranged between 16ºC to 30ºC . Was begin a hundred and forty chick, one day old unsexed broiler chicks (35 for each strain, Arber Acer, Cobb500, Hubbard15 and Ross308 strain), were randomly assigned in Complete randomized design. with five replicates (7 chicks per each).. fed adlibitum on balanced ration and available water. Study two comparison deferent between breeds and its standard and between breeds. Feed intake, body weight and feed conversion ratio were recorded on weekly basis throughout the entire duration of experiment, was calculated per bird.

Five chicks from each group were slaughtered to calculate carcass characteristics, and sensory evolution the data analyzed by Statistix10 trial program from which the one-way ANOVA.

The results showed that there was significantly different ($p<0.05$) between Ross308 and Hubbardf15 breeds in the average final body weight but it was not significantly different ($p>0.05$) between Arbor Acer and Cobb500 and Hubbardf15, and between Ross308 and Cobb500 and Arbor Acer. And was showed significant differences ($p<0.05$) between Ross308 and Hubbardf15and Cobb500breeds in average feed intake during the experiment 5th weeks while there were not significant differences ($p>0.05$)

between Arbor Acer and Cobb500 and Hubbardf15, and between Ross308 and Arbor Acer.

While showed significant differences ($p<0.05$) between Cobb and another breeds in the average the feed conversion rations during the experiment 5th weeks for the Arbor Acer, Cobb, Hubbard and Ross breeds

A high significantly differences ($p<0.05$) in Mortality rate between all breeds Arbor Acer, Cobb, Hubbard and Ross breeds

A no significant differences ($p>0.05$) in dressing percentage between breeds Arbor Acer, Cobb, Hubbard and Ross breeds

There were no significant differences ($p>0.05$) in percentage of liver, heart, gizzard and abdominal fat between breeds Arbor Acer, Cobb, Hubbard and Ross. but there were significantly differences ($p<0.05$) in percentage of neck between breeds .

There were no significant differences ($p>0.05$) in percentage of commercial cuts, thigh and drumstick between breeds Arbor Acer, Cobb, Hubbard and Ross. but there were significant differences ($p<0.05$) in percentage of Breast between breeds Arbor Acer, Cobb, Hubbard and Ross . Also there were not significant differences ($p>0.05$) in meat and bone percentage of commercial cuts thigh and drumstick between breeds Arbor Acer, Cobb, Hubbard and Ross. but significant differences ($p<0.05$) were showed in meat and bone percentage of Breast between breeds Arbor Acer, Cobb, Hubbard and Ross.

The Sensory evaluation of meat were not significantly differ in flavor between all breed Arbor Acer, Cobb, Hubbard and Ross, but were significant differences ($p<0.05$) between breeds in color, tenderness and juiciness was reported .

ملخص البحث

أجريت هذه التجربة لدراسة الأداء الإنتاجي وخصائص الذبيح لأربع سلالات لاحم تجارية الأربوريكر, الكوب, الهبارد والروس في مزارع قسم الإنتاج الحيواني لكلية الدراسات الزراعية بجامعة السودان للعلوم والتكنولوجيا في الفترة من خمسة ديسمبر إلي تسعة يناير 2015-2016 تحت دراجات حرارة جوية 16-30مº بدأت التجربة بمائة وأربعون كتكوت عمر يوم غير مجنسة 35 كتكوت من كل سلالة وزعت حسب التصميم الكامل العشوائية لخمسة مكررات في كل مكرر سبعة كتكوت. غذيت لحد الشبع بعلائق مثالية وتوفرت مياه الشرب. درست المقارنة بين السلالة ومقايسها المثلي وبين السلالات مع بعضها في بعض الصفات مثل الوزن الحي والعليقة المستهلكة ومعدل التحويل الغذائي أسبوعيا خلال التجربة والمتوسط للطائر الواحد. تم ذبح خمسة دجاجات من كل سلالة وتسجيل كل البيانات الخاصة بالذبح بجانب قيم اللحم الانطباعية. تم استخدام الحاسوب للتحليل البيانات احصائيا عن طريق البرنامج الاحصائي statistix10 trial باستخدام الطريق one-way ANOVA.

أظهرت الدراسات وجود فروق معنوية في متوسط الوزن الحي بين السلالات الهابرد والروس في حين لاتوجد فروق معنوية الاربوريكر والكوب و الهابرد وكدلك الاربوريكر والكوب و الروس.

كما أظهرت الدراسة وجود فروقات معنوية في متوسط استهلاك العلف بين السلالات الكوب والهابرد و الروس

كما أظهرت الدراسة وجود فروقات معنوية في متوسطات معدل التحويل بين سلالة الكوب وباقي السلالات.

كما أظهرت الدراسة وجود فروقات معنوية في نسبة النفوق بين كل السلالات.

وعند حساب نسبة التصافي لم تسجل فروق معنوية , ولم يجد فروقات معنوي عند حساب نسب الاجزاء الماكولة الكبد والقانصة والقلب ودهن الاحشاء وفي حين وجدت فروق معنوية في نسبة الرقبة, كما لم توجد فروقات معنوي عند حساب نسب القطع التجارية الفخذ والساق ولكن وجددت فروقات معنوية في نسبة الصدر .لم تسجل نسبة التشافي لقطعتي الفخذ والساق فروقات معنوية في حين سجلت فرق معنوي لقطعه الصدر.اما اختبار التذوق لم يظهر فروق معنوية للنكهة في حين سجل فروقات معنوية للون والطراوة والعصيرية .

Contents

List of Tables

List of Figures

List of Appendix

CHAPTER ONE

Introduction

The modern broiler industry started in the Delmarva region of the USA in the mid 1930's. Inducements into this new industry were a general decline in the traditional shell fishing and fruit growing industries of this region, together with the fact that there was a large local market that could easily be served with supply of fresh product. The move from egg to meat production was also hastened due to the fact that Leghorn birds were experiencing high mortality from what was later to be known as Marek's disease. At this time, the broiler strains seemed more resistant to the disease, a fact likely associated with the much shorter life-cycle of the new fast growing birds. New Hampshire also quickly developed a new broiler industry, although this New England region was soon to become more important as the location of many influential primary breeding companies. The willingness of primary breeders to locate in this area was greatly helped by an active and effective pullorum testing program. While the North Eastern USA was quickly becoming a leader in broiler production (Leeson and Summer 2009)

Sudan is a very large country with an area of 1861484 million km², it is rich in flora and fauna(Berry 2015).

Most of populations depending on their income from land. The high monetary value of various agricultural cash crops and relative ease with which markets are found have brought considerable progress in agricultural production.

The development in livestock and poultry production far short in progress compared to agriculture. This may be due to the fact that poultry

meat and eggs are perishable commodities, and industrial development has been very slow in developing countries .The function of poultry industry is the conversion of feed in a form that is prized for human food (Oluyemi 1979).

The importance of poultry meat production in the Sudan has increased recently due to higher meat demand by consumers with reflecting increases in population incomes and standard of living. The poultry meat has provided to be one of the best sources in order to cover the shortage in the market demand now a day. Household tends to reduce their consumption of high cost of red meat and move towards other meat resources like chickens and fish.

Commercial Poultry production is Sudan is divided onto three farming system: Open System, Semi Closed system, closed system. Khartoum State produce almost 90% of Sudan's poultry production. (Sirdar 2014) showed appendix-1 Sudanese annual meat and eggs Production.

The commercial broilers production in Sudan and other tropical countries are based on European breeds .The exotic breeds in the Sudan are faced by the hazards of the tropical environmental condition under open sided houses system particularly during the summer season. Experiments from different African countries showed that imported breeds have more mortality rates than native breeds when both were raised under the same environmental condition and the growth rate and feed intake are lower than that in the temperate zone due to higher temperature as reported by Nwosu *etal* (1984), Sulieman (1996), Yousif (1987) and Beker and Banerjee (1993).

The objectives of the present study are to:-

1- Identify the performance of the commercial broilers Arbor Acres broiler breed, Cobb500 broiler breed, Hubbard 15 broiler breed and Ross308 broiler breed) in Sudan.
2- Comparison between of each of the four mentioned breed and its stander.
3- Compare carcass characteristics of the four mentioned breeds.
4- Compare the meat quality of the four mentioned breeds.

CHAPTER TWO

Literature Review

2.1 Factors affecting broiler growth and quality.

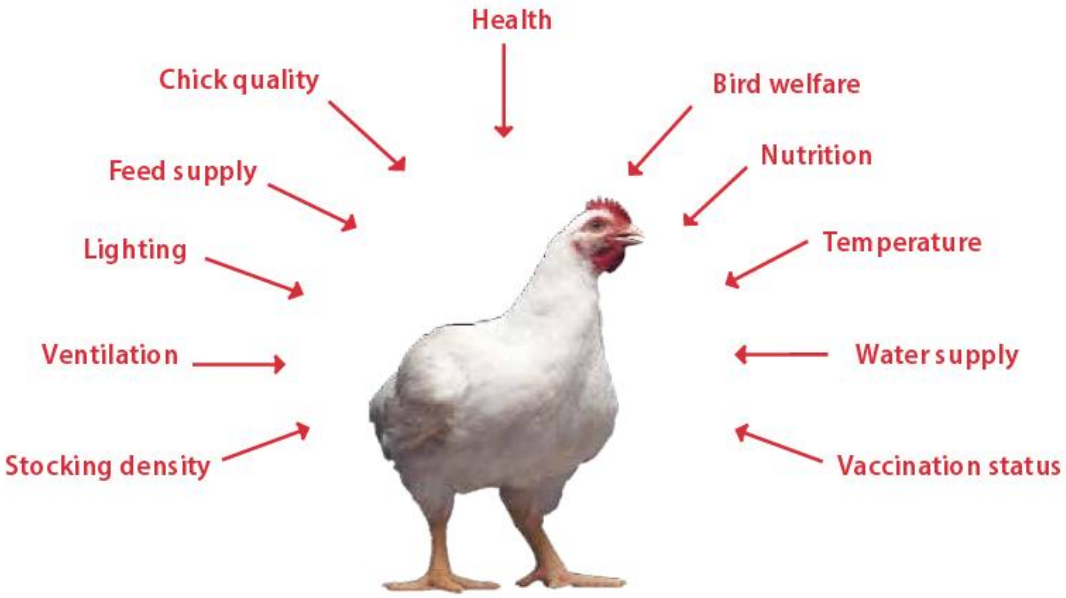

Figure 2- 1 showing Factors affecting broiler growth and quality for (M.H.B.A2014) and (M.H.B.R2014)

2.2 General environment:

Before getting in to specific requirements, it should be that there is a great deal of disagreement of the ideal temperature range for the different classes and age groups of poultry. this probably due to the fact that many factor influence the reaction of poultry to temperature changes. Humidity of the atmosphere, wind velocity and previous acclimatization of the bird are among the most important birds, in general, perform well within a relatively wide temperature range. This range, which extends between 10 and 27°C, is

not too different for broilers (Milligan and Winn 1964; Mardsen and Morris 1987).

(Kampen 1984) found that the highest growth rate of broilers occurs in the range of 10-22°C.

As for the optimum temperature range, (Charles 2002) reviewed the literature on the optimum temperature for performance and conduced that for growing broiler it is 18-22°C. we know, however, that what is ideal for growth is not ideal for feed efficiency is not ideal for egg weight for example, we know that feed efficiency is not always reduced at temperatures below21°C egg production and growth rate are reduced at temperatures below 10 the overall optimum range is mainly dependent on the relative market value of the product produced, in proportion to feed cost. as the price ratio widens, the best temperature falls, and vice versa.

2.3 Breeds:

Consideration of poultry as a source of meat, rather than just for egg production, started in the early 1900's a number of different breeds were initially used for producing meat Strains suitable for the fledgling broiler industry. Initially there was emphasis on crossbreeding of several strains with focus on such traits as auto color sexing as well as growth and meat yield, (Leeson and Summer 2009)

Table 2−1 showing the development of broiler breeds

Table 2- 1 Growth characteristics of mixed -sex broilers:

Time Period	Age (days)	Live wt Kg	Live wt Gain (g/day)	Feed Gain	Mortality (%)
1920`s	120	1.0	8	5.0	20
1930`s	100	1.2	12	4.6	15
1940`s	85	1.4	17	4.0	10
1950`s	75	1.5	20	3.2	8
1960`s	70	1.6	23	2.5	8
1970`s	60	1.9	32	2.2	5
1980`s	50	2.2	44	2.0	5
1990`s	50	2.6	51	1.9	4

(Leeson and Summer 2009)

2.3.1 Sudanese Indigenous Chickens: -

Desai (1961) was the first investigator to collect data in the production of indigenous Sudanese chickens; he classified them into three types:

- The large baladi birds.
- The Bare Neck birds.
- The Betwil birds.

- **l arge baladi birds:**

It is the most common type in Sudan characterized by a good body weight reaching 1360 grams at maturity. It has a wide range of colored, feather and

small crushed comb. Average egg production 84 eggs per year, mean egg weight 42.5gms, fertility 89%, hatchability of egg set 78.8%, hatchability of fertile eggs 88%, mean weight at 12 month for males 1881 gins, for female 1373ns. These body weights of males and females suggested the potential to use large baladi as meat type birds (Yousif, 1987).

- **Bare neck birds:**

Bare neck is predominant in the Southern part of Sudan. It is characterized by feather less neck and small body weight at maturity (1100) gins under improved management conditions, egg production may reach 100 eggs/ year, mean egg weight is 40 gm, it is possible that the Bare .neck in Sudan resemble the Bare Neck birds indigenous in Asia, Central America and Europe (Horst and Rauen, 1986).

- **The Betwil birds:**

It is small type found at the Nuba mountains region in Kordofan State, it is characterized by compact body weight at maturity (1.5-2) kgs and it possesses tiny black legs., Betwil was considered as better layer (70_80 eggs/year). Under controlled conditions the average egg production increase to 90 eggs /year (Desai 1962). Betwil and Bare Neck type are more uniform in feather color than the large baladi.

2.3.2 Exogenous and International broiler breeds:

Most of the commercial intensive broiler production in the Sudan and other tropical countries is based on exotic specialized European breeds which are selected for higher performance in comparison to the indigenous

unimproved chickens which are being kept in rural areas under local traditional systems (chhbarda and sapra 1973) and (Mohamed 1987).

During the 60s, few private producers started to raise poultry for commercial purposes mainly around the capital Khartoum. Initially they relied on kuku governmental unit for the supply of chicks, but eventually some of them began importing day-old chicks of pure breeds and hybrids from Europe, Marshall11 p12, Ross1, Shaver starbro, cobb55, Lohman, Arbor Acrs, H and N meat Nick and Hybro breeds with the flow of importation still going on.

It is well recognized that exotic breeds in Sudan and other tropical countries are subjected to the hazards of the tropical environmental conditions under the open system particularly during summer season when their temperate performance standard decline due to the high environmental temperature (Deaton *et al* 1968, Griffin and Vardaman 1971, Hassan *et al* 1973, Dyime 1980)

2.3.3 **International breeds**:

- **Barred Rock:**

Because of its popularity at Cornell University and the University of Guelph, this breed was promoted as a meat producing bird in the early 1900's. Apart from having only moderate growth potential compared to some other breeds, a subsequent disadvantage was the dark pin feathers associated with its feather color.

- **White Plymouth Rock:**

Developed in the New England States in the 1870's, this breed was to become the choice for female lines within most breeding programs. Its main advantage was white plumage, and while initially most birds were slow

feathering, this characteristic was quickly changed to the fast feathering allele.

- **New Hampshire**:

Also used on the female side of early broiler breeding programs, the New Hampshire had reasonable growth characteristics and good egg production and hatchability. As with the Barred Rock, its red/brown plumage prevented the breed from being used exclusively in the female lines of commercial programs.

- **White Cornish:**

With white feathers and yellow skin the White Cornish offered great potential for establishing white feathered broilers in the1920's-30. With relatively short legs and a heavily muscled broad breast, the breed quickly became established as a major contributor to the male lines within the breeding programs. Because of relatively poor egg production, the Cornish were little used in female lines of the 3 or 4way crosses that were to become the most popular breeding systems.

- **Light Sussex:**

More popular in Europe, the Light Sussex was somewhat comparable to the New Hampshire in the USA, in providing a breed that could be reasonably well used in either male or female lines. Over time, the White
Cornish male crossed with the White Plymouth Rock female became the basis for most broiler breeding programs. In addition to being white feathered, the cross gave an excellent balance of growth, conformation and livability together with a reasonably good level of reproduction. (Hunton 1990. and Leeson and Summer 2009)

2.3.4 Primary Breeders Companies:

These are the international breeding companies that develop modern lines of commercial poultry. (Elfick 2012)

- **Aviagen Group:**

Is the world's leading poultry breeding company, developing products to meet the needs of the commercial broiler and turkey industries. Formed in 1999, the company now combines poultry breeding resources and expertise across its brand portfolio, which includes Ross, Arbor Acres, Lohmam Indian River, CWT Farms and Nicholas.

- **Aviagen: Arbor Acres:**

Is a supplier of primary broiler breeding stock to the worldwide poultry industry.

- **Aviagen: Ross:**

Is the world’s number one broiler breeder brand

- **Cobb-Vantress**:

Is a poultry research and development company engaged in the production, improvement and sale of broiler breeding stock.

- **Hubbard:**

From the small flock of chickens with which Ira and Oliver Hubbard began the business in 1921, Hubbard has grown to one of the major international broiler breeding companies in the world. The poultry industry has seen remarkable changes during the past 90 years, with dramatic results for the benefit of humankind. Hubbard has played, and will continue to play, an important and vital role in this great industry.

2.4 Production traits:

2.4.1 Body weight:-

Growth rate and final body weight in poultry differ between breed strains, and lines and within one line according to genetic composition of the individual even if they reared under similar environmental condition or ages.

Many research studies in department of Animal production farm - college of Agricultural Studies - Sudan University of Science and Technology in an open poultry shed (Osman.2015) and (salih.2015) found that the body weight of Arbor Acres breed at the age of five weeks and sex weeks were 1898g, and 1380g respectively, (Saad.2015) and (Ali.2015) found the body weight for Cobb500 breed at the age of five weeks were 1569.95g, and 1313g respectively, (Shareif.2013) , and (Mustafa.2014) found the body weight for Hubbard f15 breed at the age of sex weeks were 1483.33g, and 1081g, and (Hamed.2014) , and (Mohammed.2006) found the body weight for Ross308 breed at the age of sex weeks were 1794g, and 1873.15g respectively.

(Rokon *et al* 2015) stated the Production performance of three broiler strains in summer seasons in Bangladesh in an open poultry shed and reported the body weight of broiler strain in different weeks of summer season is cleared that the highest body weight of Cobb500 was 181.99g in first week of age in summer season followed by 170.17g and 151.55g in Hubbard Classic and Arbor Acres broiler strain, respectively. In second week the satisfactory body weight 525.84g was observed in Hubbard Classic, 452.00g in Arbor Acres and 419.23g in Cobb500. The third weeks and fourth weeks were also highest body weight 831.97g and 1306.57g in Hubbard Classic than the

other two broilers strain 787.07g and 1186.66g in Cobb500; 792.06g and 1233.40g in Arbor Acres in summer season.

(Rokonuzzaman *et al* 2015) stated the Growth performance of three broiler strains in winter seasons in Bangladesh in an open poultry shed and reported The live weight of three broiler strains in different weeks of winter season is the Arbor Acres was expressed highest body weight 119.78g in first week of age in winter season followed by 119.22g and116.27g in Cobb500 and Hubbard Classic broiler strain, respectively. In second week the live weight 286.25g was observed in Cobb500, 274.35g in Hubbard Classic and 267.54g in Arbor Acres. The third weeks and fourth weeks were also highest body weight 675.39g and 1178.1g in Arbor Acres than the other two broilers strain 627.85g and 1089.6g in Cobb500; 617.17g and 1101.3g in Hubbard Classic in winter season.

2.4.2 Feed intakes:-

Proper nutrition play a very important role programmed for the important of the poultry production.

Many research studies in department of Animal production farm - college of Agricultural Studies - Sudan University of Science and Technology in an open poultry shed (Osman.2015) and (salih.2015) found that the feed intake of Arbor Acres breed at the age of five weeks and sex weeks were 2294g, and 2500g respectively, (Saad.2015) and (Ali.2015) found that the feed intake of Cobb500 breed at the age of five weeks were 3269.73g, and 2921g respectively, (Shareif.2013) , and (Mustafa.2014) found that the feed intake

of Hubbard 15 breed at the age of sex weeks were 1295.25g, and 2830.25g respectively, and (Hamed.2014) and (Mohammed.2006) found that the feed intake of Hubbard 15 breed at the age of sex weeks were 3239g and 4102g respectively.

(Rokon *et al* 2015) stated the Production performance of three broiler strains in summer seasons in Bangladesh in an open poultry shed and reported Feed intake of broilers in different weeks is evident that feed consumption of Cobb500, Hubbard Classic and Arbor Acres was 124.88g, 148.80g and 104.44g per broiler strain, respectively during the first week of age. The highest value of feed intake was 148.80g in Hubbard Classic. In second weeks the highest feed intake 540.26g was observed in Hubbard Classic broiler strain followed by 457.61g and 409.62g in Cobb500 and Arbor Acres broiler strain respectively, the third weeks and fourth weeks feed intake of Hubbard Classic were 1067.71g and 1753.36g. These were the highest value among the three strains. Since first week to fourth weeks Hubbard Classic was continued the highest feed consumption than other two broiler strain.

(Rokonuzzaman *et al* 2015) stated the Growth performance of three broiler strains in winter seasons in Bangladesh in an open poultry shed and reported the average feed intake of three broiler strains in different weeks is the feed consumption of Cobb500, Hubbard Classic and Arbor Acres was 89.4g, 107.66g and 104.02g per broiler strain, respectively in first week of age. The highest value of feed intake was 107.66g in Hubbard Classic. The highest feed intake 348.04g was observed in Hubbard Classic broiler strain in second week followed by 332.97g and 331.17g in Arbor Acres and Cobb500, respectively. The third weeks and fourth weeks feed intake of Cobb500 were 873.53g and 1649.5g. These were the highest value among

the three strains. Since first week to second weeks Hubbard Classic and third weeks to fourth weeks Cobb500 was continued the highest feed consumption than other two broiler strains.

2.4.3 Feed conversion ratios (FCR):-

The exotic breed proved to be higher efficient in feed conversion ratio compared to the indigenous chicken.

Many research studies in department of Animal production farm - college of Agricultural Studies - Sudan University of Science and Technology in an open poultry shed (Osman.2015) and (salih.2015) found that the FCR of Arbor Acres breed at the age of five weeks and sex weeks were 1.5 and 2 respectively, (Saad.2015) and (Ali.2015) found that the FCR of Cobb500 breed at the age of five weeks were 2.09 and 2.23 respectively, (Shareif.2013) , and (Mustafa.2014) found that the FCR of Hubbard 15 breed at the age of sex weeks were 2.18 and 2.34 respectively, and (Hamed.2014) and (Mohammed.2006) found that the FCR of Hubbard 15 breed at the age of sex weeks were 1.8 and 2.19 respectively.

(Rokon *et al* 2015) stated the Production performance of three broiler strains in summer seasons in Bangladesh in an open poultry shed and reported Feed conversion ratio of broiler strain in summer season was the FCR value of Cobb500, Hubbard Classic and Arbor Acres was 0.68, 0.87 and 0.69at first week of age, respectively. In second week, the highest FCR value was 1.11 in Cobb500 and lowest 0.91 in Arbor Acres. At the end third

week of age FCR 1.19, 1.28 and 1.21 were found in Cobb500, Hubbard Classic and Arbor Acres, respectively. The lowest FCR value at fourth weeks of age was 1.34 in Hubbard Classic, highest 1.38 in Arbor Acres and 1.36 in Cobb500.

(Rokonuzzaman *et al* 2015) stated the Growth performance of three broiler strains in winter seasons in Bangladesh in an open poultry shed and reported in winter season the feed conversion ratio (FCR) of three broiler strains is the first week of age of broilers, FCR value of Cobb500, Hubbard Classic and Arbor Acres was 0.74, 0.93 and 0.87, respectively, the second weeks FCR value 1.27 was highest in Hubbard Classic and lowest 0.91 in Arbor Acres. At the end third weeks of age FCR 1.39, 1.19 and 1.02 were found in Cobb500, Hubbard Classic and Arbor Acres, respectively, the lowest FCR value at fourth weeks of age was 1.37 in Arbor Acres, highest 1.53 in Cobb500and 1.39 in Hubbard Classic.

2.4.4 Mortality:-

Mortality is one of the major factors, which had an economical effect in the poultry enterprises. Mortality generally had many causative agents such as disease, accident and cannibalism. Local chicken's mortality rate is low, this is due to their adaptability to the environment, effect of genotype location, year, and tire interaction, which was found to be significant on hens, housed (wilson1986).

Many research studies in department of Animal production farm - college of Agricultural Studies - Sudan University of Science and Technology in an

open poultry shed (Akasha.2015) and (Ali.2015) reported that the mortality rate of Arbor Acres and cobb500 breeds were 0 respectively, (Shareif.2013) and (Mustafa.2014) reported that the mortality rate of Hubbard breed were 3.06% and 2.86% respectively, and (Hamed.2014) and (AbdAlla.2012) reported that the mortality rate of Ross breed were 0 and 5% respectively.

(Rokon *et al* 2015) stated the Production performance of three broiler strains in summer seasons in Bangladesh in an open poultry shed and reported the mortality percentages of three strains in summer season were evident that there were no mortality percentages in first week. In second weeks the highest mortality percentages 8.89 were in Hubbard Classic and no mortality in Cobb500, the third week's mortality was 6.67, 8.87 and 6.67 in Cobb500, Hubbard Classic and Arbor Acres, respectively. This mortality was fixed at fourth weeks of age.

(Rokonuzzaman *et al* 2015) stated the Growth performance of three broiler strains in winter seasons in Bangladesh in an open poultry shed and reported the mortality percentage of three strains in winter season is there was 2.22% mortality observed in Cobb500 and Hubbard Classic but no in Arbor Acres at first week of age. In second weeks the mortality percentages were 2.22 in Cobb500 and Arbor Acres, this mortality values was fixed in same broiler strain at third and fourth weeks of age except Hubbard Classic. The 4.44% mortality was shown in Hubbard Classic at second weeks of age. This value was fixed in third and fourth weeks of age.

2.5 Carcass Characteristics

2.5.1 Dressing Carcass percentage:-

Many research studies in department of Animal production farm - college of Agricultural Studies - Sudan University of Science and Technology in an open poultry shed (Osman.2015) and (salih.2015) found that the values for dressing percentage of Arbor Acres breed were 72.2% and 69.6% respectively. as well (Saad.2015) and (Ali.2015) found that the values for dressing percentage of a Cobb500 breed were 68.95% and 63.83% respectively. as well as (Shareif.2013) and (Mustafa.2014) found that the values for dressing percentage of Hubbard 15 breed were 74.4% and 60.11% respectively. as well as (Hamed.2014) and (Mohammed.2006) found that the values for dressing percentage of Ross308 breed were 71.2%-68.21% respectively.

(Rokon *et al* 2015) stated the Production performance of three broiler strains in summer seasons in Bangladesh in an open poultry shed and reported the dressing percentages of three broiler strains in summer season were it was evident that the dressing percentage value was 64.95 in Cobb500. It was the highest values than other two broiler strain followed by 57.42 in Hubbard Classic and 55.57 in Arbor Acres at fourth weeks of age.

(Rokonuzzaman *et al* 2015) stated the Growth performance of three broiler strains in winter seasons in Bangladesh in an open poultry shed and reported In winter season the dressing percentages of three broiler strains, the dressing percentage value 55.85 was found in Hubbard Classic. It was the highest values than other two broiler strain followed by 54.59 in Cobb500 and 52.29 in Arbor Acres at fourth weeks of age.

2.5.2 Non carcass component:-

Many research studies in department of Animal production farm - college of Agricultural Studies - Sudan University of Science and Technology in an open poultry shed (Osman.2015) Reported for Arbor Acres breed that the Percentage yield of liver .64, heart .22, gizzard .5, head .57and fat .17.

(Saad.2015) Reported for Cobb500 breed that the Percentage yield of liver 2.79%, heart.75%, gizzard 2.71%, intestine 5.58% and fat .17, and (Ali.2015) Reported that the Percentage yield of liver 2.52%, heart.36%, gizzard 1.66%, neck 4.6% and fat 1.33%.

(Shareif.2013) Reported for Hubbard f15 breed that the Percentage yield of of liver 3.66%, heart.66%, gizzard 3.5%, intestine 5.58% and abdominal fat 2.33, and (Mustafa.2014) Reported that the Percentage yield of liver 3.35%, heart 2.36%, gizzard 2.72%.

(Hamed.2014) Reported for Ross308 breed that the Percentage yield of liver 2.15%, heart.6%, gizzard 2.12%, and (Mohammed.2006) Reported that the Percentage yield of liver 3.58%, heart 1.15%, gizzard 6.7%.

2.5.3 Percentage yield of commercial cuts :-

(Weir 1960) reported that the average Percentage yield for cut–up parts form fryers based on chilled and ready –to- cook weight were approximately as follow:

(Saad.2015) reported for Cobb500 that the breast Percentage 24.43% and meat Percentage 81.79% , thing Percentage 19.29% and meat Percentage 83.23%, drumstick Percentage 19.10% and meat Percentage 75.58%. and (Ali.2015) reported that the breast Percentage 17.93% and meat Percentage 82.96% and bone Percentage 16.59% , thing Percentage 7.12% and meat Percentage 78.91% and bone Percentage 21.09%, drumstick Percentage 9.2% and meat Percentage 81.47% and bone Percentage11.99.

(Mustafa.2014) reported for Hubbard f15 that the breast Percentage 42.29%, thing Percentage 24.52%, drumstick Percentage 27.69% .

(Hamed.2014) reported for Ross308 that the breast Percentage 24.49% and meat Percentage 81.87% , thing Percentage 19.35% and meat Percentage 83.27%, drumstick Percentage 19.14% and meat Percentage 70.4%. (Elsaeed.2012) reported that and the breast Percentage 23.4% and meat Percentage 79.48% and bone Percentage 20.4%, thing Percentage 19.3% and meat Percentage 80.75% and bone Percentage 19.25%, drumstick Percentage 16% and meat Percentage 70.26% and bone Percentage 29.76%.

2.5.4 Sensory evaluation:-

(Weir 1960) reported that the palatability attributes like tenderness and juiciness are more important to the average consumers .the overall impression of the tenderness to the palate includes texture and involves three aspects: firstly, the initial ease of penetration of the meat by the teeth, secondly, the ease with which the meats break into fragments; and thirdly the amount of residue remaining after chewing. he also reported that the juiciness in cooked meat has two organoleptic components. The first is the impression of moistness during the first chews is produced by rapid release of meat fluid; the second is the stimulatory affect of fat on salivation.

Many research studies in department of Animal production farm - college of Agricultural Studies - Sudan University of Science and Technology in an open poultry shed (salih.2015) found that the values for tenderness, juiciness, color and flavor of Arbor Acres breed were 6.18, 6, 6.1 and 6.1 respectively.

(Saad.2015) and (Ali.2015) found that the values for tenderness, juiciness, color and flavor of Cobb500 breed were 6.51 and 5.3, 5.8 and 6.2, 6.2 and 5 and 6.17 and 5.9 respectively. as well as (Shareif.2013) and (Mustafa.2014) found that the values for tenderness, juiciness, color and flavor of Hubbard15 breed were 5 and 6.5, 5.6 and 6, 6.6 and 6.6 and 5.5 and 6 respectively.

(Hamed.2014) and (Mohammed.2006) found that the values for tenderness, juiciness, color and flavor of Ross308 breed were 6.65 and 6.4, 6.33 and 6.2, 6.1 and 5.6 and 6.4 and 6.4 respectively.

CHAPTER THREE

Material and Methods

3.1 Location and Duration:

the experiment was carried out at the department of Animal production , College of Agricultural Studies, Sudan University of Science and Technology, in Poultry Farm during the period from5 December2015 and ending on 9January2016 (35days) . which the ambient temperature ranged between 16ºC to 30ºC .

3.2 Housing:

An open system Poultry house was used, East-West long axis , the house dimensions were length and width and height14×8×2.5m respectively. Twenty seprate replicates of equal size $1m^2$ each were used wire net partitions, each replicates was provided with wood shaving litter and feeder and drinker to allow optimum consumption of feed and water were supplied ad libitum heat lamps were used for the control of heating and lighting and had put in away to ensure adequate and uniform distribution of heat and light , light was open during the period of whole night ,to protect the chicks from cold .

Strict sanitation program were maintained in the house before and during the period of experiment.

3.3 Experimental birds:

There were to two group:

Used the standard it's all breed :

-Arbor Acres broiler breed, for (M.H.B.A2014)

-Cobb500 broiler breed, for (M.H.B.C2012)

-Hubbard 15 broiler breed, for (M.H.B.H2015)

-Ross308 broiler breed, for (M.H.B.R2014)

b- Hundred and forty unsexed commercial broiler chicks in one day old were used as follows:

-35chicks of (A) Arbor Acres broiler breed,

-35chicks of(C) Cobb500 broiler breed,

-35chicks of(H) Hubbard 15 broiler breed,

-35chicks of(R) Ross308 broiler breed

each breeds had five replicates of 7 birds each.

Chicks were vaccinated against infectious bronchitis disease (IBD) and the first dose of Newcastle disease at age of 7 days , the first dose of Gambaro disease at age of 14 days and second dose at age 20 days , and the second dose of Newcastle disease at age 29 days .

Chicks in all groups have been given water soluble multivitamin compounds during the first three days of age and 24&25&26 days of age and before and after vaccination to avoid the stress.

3.4 Experimental diet:

The birds in the experiment were fed adlibitum on balanced ration , one of ration available in the market that:

in first week we used pre starter plets rations

in second and third week we used starter plets rations

and in last two week we used finishing plets ration ,

clean and fresh water was available throughout the day .

Table 3- 1 Chemical analysis Composition of the experiment pre- starter ration

Items	**value**
ME(kcal)	3200
Fat%	7
C.P %	22
Sodium%	19
Lysine%	1.3
methionine%	0.55
meth+cyst%	0.95
calcium%	0.95
total phosphorus%	0.65

Table 3- 2 Chemical analysis Composition of the experiment ration (starter and finisher)

Items	**Starter**	**Finisher**
moisture%	6.84	7.5
Crude Fat%	4.96	6.1
Crude protein%	24.37	22.96
Crude fiber%	4.41	4.58
ash%	5037	5.09

3.5 Parameters:

-body weight were recorded weekly.

- feed intake were recorded weekly.

-feed conversion ratio (FCR) were also calculated

Feed conversion ratio (FCR) = feed intake/ body weight

- mortality was recorded daily in period

mortality ratio% = died bird/total bird ×100.

3.6 Carcass preparation

At the end of 5^{th} weeks experiment the birds were fasted over night from feed but water available, one bird from each replicate was randomly selected, the birds were weighted individually before slaughter. Slaughtered allowed to bleed , then scalded by using boiling water , they were scale and defeathered manually , washed and drained after evisceration the hot carcass was weight , the individual organs , liver, heart, gizzard , fat and neck were separated and weighted. the carcasses were then chilled in refrigerator at 4ºC for 24 hours . then the carcass was cut into different commercial cuts . Cutting along the keel bone halved the breast, drumstick and thigh. the individual cuts were weighted separately. and the meat and bone were weighted separately in order to calculate the meat to bone ratio .

3.7 Panel test:

The stored left of carcasses was slightly seasoned wrapped individually in aluminum foil and roasted at 190C for 70 minutes with average internal temperature of 88C and served warm.

an ten trained panelist were used to score color, tenderness, juiciness and flavor of the roasted meat these samples served randomly to each judge. Water was available between sample. 3replicates were used

3.8 Calculation:

The hot carcass weight was expressed as a percentage of live weight to give the dressing percentage. the weight of non- carcass components such as liver, heart, gizzard abdominal fat and neck weight . the different commercial cuts weight were expressed as a percentage of the hall carcass weight. meat and bone were weighted and expressed as a percentage of weight its cut.

3.9 Statistical analysis:

Complete randomized design CRD was used in this experiment. The experimental data was analyzed by using the statistix10 trial according to (statistix 2013). the analysis of variance (one-way ANOVA) was used to compare between the groups.

CHAPTER FOUR

Results

The total number at the commencement of experiment was 140 birds that 35 chicks of Arbor Acres broiler breed (A), 35 chicks of Cobb500 broiler breed (C), 35 chicks of Hubbard15 broiler breed (H) and 35 chicks of Ross308 broiler breed (R).

4.1 Comparison between the breed and it's standard:

4.1.1 Arbor Acres (A):-

By the end of experiment at 5^{th} week the differences between the average final body weight and feed conversion rations of the Arbor Acres breed and its standard were not significant ($p>0.05$).while the average feed intake of (A) was significantly ($p<0.05$) higher than (Ast) as shown in table 4-1 and appendix-3-7-8 and 9.

Table 4- 1 means ± SEM of final body weight, feed intake and feed conversion rations of Arbor Acres breed (A) and its standard (Ast)

Item	Ast	A
Final body weight	2136a	2161±19.11a
feed intake	3342b	3429.1±32.53a
FCR	1.565a	1.587±.016a

Ast: standard of Arbor Acres breed from (M.H.B.A2014).

A: Arbor Acres breed under study.

Means on the same row having different superscripts are significantly different ($p<0.05$).

4.1.2 Cobb500(C):

By the end of experiment at 5th week the differences between the average final body weight, feed intake and feed conversion rations of the Cobb500 breed and its standard were not significant ($p>0.05$), as shown in table 4-2 and appendix-4-10-11 and 12.

Table 4- 2 means ± SEM of final body weight, feed intake and feed conversion rations of Cobb500 breed (C) and its standard (Cst):

Item	Cst	C
Final body weight	2067a	2135.1±84.03a
feed intake	3216a	3210.9±123.88a
FCR	1.556a	1.504±.026a

Cst: standard of Cobb500breed from (M.H.B.C2012)

C: Cobb500breed under study.

Means on the same row having different superscripts are significantly different ($p<0.05$).

4.1.3 Hubbardf15 (H) :-

By the end of experiment at 5th week the differences between the average final body weight, feed intake and feed conversion rations (FCR) of the (H) and its standard (Hst) were significant ($p<0.05$) that (H) was higher than (Hst)**,** as shown in table 4-3 and appendix-5-13-14 and 15.

Table 4- 3 means ± SEM of final body weight, feed intake and feed conversion rations of Hubbardf15breed (H) and its standard (Hst)

Item	Hst	H
Final body weight	1894b	2065±22.58a
feed intake	2967b	3348±37.53a
FCR	1.567a	1.621±.005b

Hst: standard of Hubbard15 breed from (M.H.B.H2015)

H: Hubbard15 breed under study

Means on the same row having different superscripts are significantly different ($p<0.05$).

4.1.4 Ross308 (R):

By the end of experiment at 5th week the differences between the average feed conversion rations (FCR) of the (R) and its standard (Rst) were not significant ($p>0.05$).while the average final body weight and feed intake of (R) was significantly ($p<0.05$) higher than (Rst)**.** as shown in table4-4 and appendix-6-16-17 and 18.

Table 4- 4 means ± SEM of final body weight, feed intake and feed conversion rations of Ross308breed(R) and its standard (Rst):

Item	Rst	R
Final body weight	2113b	2318.8±24.81a
feed intake	3331b	3670.5±64.87a
FCR	1.576a	1.582±.018a

Rst: standard of Ross308 breed from (M.H.B.R2014)

R: Ross308 breed under study.

Means on the same row having different superscripts are significantly different ($p<0.05$).

4.2 Comparison between breeds:

4.2.1 Production Traits :

Table 4-5 showed the means ± SEM of final body weight, feed intake, feed conversion rations and Mortality Rate of four breeds (A, C, H, and R) at the 5^{th} week of age (end of experiments). The results revealed that there were significant differences ($p<0.05$) between R and H. in average final body weight while there were no significant differences ($p>0.05$) between A and C and H, and between R and C and A, as showed in appendix-19

The differences between four breed were significant ($p<0.05$) in feed intake which was higher significant ($p<0.05$) for R Compare with H and C, while there were no significant differences ($p>0.05$) between A and C and H , and between R and A, as showed in appendix-20

The differences between four breed was significant ($p<0.05$) in feed conversion rations it was significant ($p<0.05$) for (C) Compared with (A, H, R), while there were no significant differences ($p>0.05$) between A and H and R, as showed in appendix-21

The differences between four breeds were significant ($p<0.05$) in Mortality rate ($p<0.05$) for all breeds (A, C, H, R).

Table 4- 5: means ± SEM of final body weight, feed intake, feed conversion rations and Mortality rate of breeds:

Items	A	C	H	R
Final body weight	2161±19.11ab	2135.6±84.03ab	2065±22.58b	2318.8±24.81a
feed intake	3429.1±32.53ab	3210.9±123.88b	3394.1±37.53b	3670.5±64.87a
FCR	1.587±.016b	1.504±.026a	1.621±.005b	1.582±.018b
Mortality%	4.85%d	8%b	5.76%c	15%a

Means on the same row having different superscripts are significantly different ($p<0.05$).

4.2.2 Carcass characteristics :

4.2.2.1 Hot dressing percentage:-

Table 4-6 showed that, there were no significant differences ($p>0.05$) between all breeds (A, C, H, R) in value of dressing percentage.

Table 4- 6 means ± SEM s of dressing percentage of the breeds (A, C, H, and R)

Breed	Dressing%
A	68.97±.736a
C	68.71±1.78a
H	68.54±.55a
R	68.22±.95a

Means having different superscripts are significantly different ($p<0.05$).

4.2.2.2 Non carcass component:

Table 4-7 showed that, the liver, hart, gizzard, abdominal fat and neck. Expressed as percentage of hot carcass weights, There were non-significant differences ($p>0.05$) between all breeds (A,C,H,R) in liver, heart , gizzard and abdominal fat , but in neck the percentage was 4.02±.12%, 4.88±.12%, 4.65±.23% and 4.52±.23% for A,C,H and R respectively. These showed significant differences ($p<0.05$) between C and A, but there were non-significant differences ($p>0.05$) between A and H and R, and between C and H and R.

Table 4- 7 means ± SEM of Non carcass component as percentage of hot body weight of the breeds (A, C, H, and R)

Items	Liver%	Heart%	Gizzard%	Abdominal fat%	Neck%
A	2.43±.17a	0.47±.02a	1.59±.08a	1.68±.19a	4.02±.12b
C	2.44±.09a	0.58±.06a	1.99±.03a	1.77±.09a	4.88±.12a
H	2.46±.07a	0.52±.44a	1.71±.15a	1.65±.2a	4.65±23ab
R	2.61±.3a	0.44±.01a	1.51±.17a	1.66±.08a	4.52±.23ab

Within each column means having different superscripts are significantly different ($p<0.05$).

4.2.2.3 Percentage yield of commercial cuts (Breast, thigh and drumstick):

Table 4-8 showed that, there were non-significant differences ($p>0.05$) between all breed (A, C, H, R) in thigh and drumstick Percentage, but these were significant differences ($p<0.05$) in breast between A and R, and between C and R, while there were non-significant differences ($p>0.05$) in breast between H and R, and between H and C and A.

Table 4- 8 means ± SEM of Percentage yield of commercial cuts of the breeds (A, C, H, and R):

Items	A	C	H	R
Breast%	19.49±.52a	19.28±.75a	17.575±.34ab	18.37±.19b
Thigh%	15.38±.3a	15.55±.37a	15.81±.7a	15.88±.27a
Drumstick%	6.57±.4a	6.71±.21a	6.94±.35a	7.15±.31a

Within each column means having different superscripts are significantly different ($p<0.05$).

4.2.2.4 Meat and bone percentage:-

Table 4-9 showed that, the values for meat and bone were expressed as percentage from the total weight of commercial cuts (Breast ,thigh and drumstick), both meat and bone percentage were not significantly differ in thigh and drumstick Percentage between all breed (A, C, H, R), but there were significant differences ($p<0.05$) in breast meat and bone between R and (C, A), and were non-significant differences ($p>0.05$) in breast meat and bone between R and H, and between A and C and H.

Table 4- 9 means ± SEM of separate Meat and bone percentage in selected carcass cuts of the breeds

Items	A	C	H	R
Breast				
Meat%	90.41±.52a	90.99±.65a	88.82±.6ab	87.91±.6b
Bone%	9.4±.54b	9±.65b	10.95±.62ab	12.08±.6a
Thigh				
Meat%	83.82±1.12a	84.25±.44a	84.63±.52a	85.97±.62a
Bone%	16.17±1.12a	15.74±.44a	15.36±.52a	14.02±.62a
Drumstick				
Meat%	79.79±1.2a	80.07±1.37a	78.93±.87a	82.68±1.17a
Bone%	20.2±1.2a	21.03±1.14a	21.06±.87a	17.31±1.17a

Within each column means having different superscripts are significantly different ($p<0.05$).

4.2.2.5 Sensory evaluation (Color, Flavor, tenderness and juiciness):-

Table 4-10 showed that, the Sensory evaluation of meat from the commercial cuts were not significantly differ in flavor between all breed (A, C, H, R), but there were significant differences ($p<0.05$) in breeds for color, tenderness and juiciness. The tenderness were significantly differ ($p<0.05$) between A and C and H, and between A and C and R, but there were non-significant differences ($p>0.05$) in tenderness between H and R.

There were significant differences ($p<0.05$) in juiciness between A and H and C, and between R and A, but there were non-significant differences ($p>0.05$) in juiciness between H and R, and between R and C.

The results showed significant differences ($p<0.05$) in Color between H and (A, C, R), but there were non-significant differences ($p>0.05$) in color between A and C and R.

Table 4- 10 means ± SEM of Meat Sensory attributes of the breeds (A, C, H, R):

Items	A	C	H	R
Tenderness	5.16c	6.33a	5.74b	5.91b
Color	6.08b	5.74b	6.49a	6.08b
Flavor	6.33a	6.08a	6.33a	6.16a
Juiciness	4.83c	5.91a	5.41b	5.66ab

Within each column means having different superscripts are significantly different ($p<0.05$).

4.2.3 Economic appraisal:

The total cost return /net profit and profitability ratio per head of broiler breeds chicks fed for 5 weeks were shown in table 4-11. Chicks purchase management and feed cost value (SDG) where the major input considered. The selling values of meat are the total revenues obtained. The result of economical evaluation indicated that, the breeds group A, C, H, R.

Table 4- 11 Economic appraisal of experimental chicks:

Items	treatment groups			
	A	C	H	R
Cost				
Chick purchase	6.00	6.00	6.00	6.25
Management	3.00	3.00	3.00	3.00
Feed	17.15	16.05	16.97	18.35
Total cost	26.15	25.05	25.97	27.60
Revenues				
Average carcass weight	1.62	1.56	1.45	1.53
Price/Kg	28.00	28.00	28.00	28.00
Total Revenues	45.25	43.57	40.49	42.81
Total cost	26.15	25.05	25.97	27.60
Net profit/ bird	19.10	18.51	14.52	15.21
Net profit/ Kg/ meat	11.82	11.90	10.04	9.95

Total cost calculated according to January 2016

Price of feed 5 (SDG) Kg

CHAPTER FIVE

Discussion

When we Compared between breeds and its standards The final body weight of the Arbor Acer, Cobb500 breeds was not significantly differ ($p>0.05$) but Hubbardf15 and Ross308 breeds were significant differences ($p<0.05$) when compared with its standards (M.H.B.A2014), (M.H.B.C2012), (M.H.B.H2015), and (M.H.B.R2014), respectively. As shown in tables 4-1, 4-2, 4-3 and 4-4, these results might be due to the low temperatures in this winter, which let more ideal for the temperatures required idealism 18-22ºC (Charles 2002).

While the feed intake of the, Cobb500 breed was not significantly different ($p>0.05$) but Arbor Acer, Hubbardf15 and Ross308 breeds were significant differences ($p<0.05$) when compared with its standards (M.H.B.A2014), (M.H.B.C2012), (M.H.B.H2015) and (M.H.B.R2014), respectively. As shown in tables 4-1, 4-2, 4-3 and 4-4, these results might be due to the low temperatures in this winter, which let more ideal for the temperatures required idealism 18-22ºC (Charles 2002).

For the feed conversion rations Hubbardf15 breed was significantly different but Arbor Acer, Cobb500 and Ross308 breeds were not significant differences ($p>0.05$) when compared with its standards (M.H.B.A2014), (M.H.B.C2012), (M.H.B.H2015) and (M.H.B.R2014) respectively. As shown in tables 4-1, 4-2, 4-3 and 4-4, these results might be due to the low temperatures in this winter, which let more ideal for the temperatures required idealism 18-22ºC (Charles 2002).

When we Compared between breeds the final body weight was significantly different ($p<0.05$) between Ross308 and Hubbardf15, but it was not significantly different ($p>0.05$) between Arbor Acer and Cobb500 and Hubbardf15, and between Ross308 and Cobb500 and Arbor Acer. Table 4-5. these results might be due to genetic variation among the different breeds, this is the same results found by (Suliaman *et al* 2012) who reported in summer seasons in Sudan that there was significant difference ($p<0.05$) in body weight between all strains (Ross Cobb and Hubbard), and Ross strain was highest body weight than Cobb and Hubbard. but it's not in agree with (Rokonuzzaman *et al* 2015) who reported in winter seasons in Bangladesh in four weeks of age that the body weight were not significantly different ($p>0.05$)among the three strains Cobb500, Hubbard and Arbor Acres. Where (Rokon *et al* 2015) reported that in summer season in Bangladesh in four weeks of age the weekly body weight of different broiler strains were significant differences ($P<0.05$) was also found between Hubbard and Arbor Acres, but were no significant differences ($p>0.05$)between Cobb500 and Hubbard.

While the feed intake was higher significantly ($p<0.05$) for Ross308 Compared with Hubbardf15and Cobb500, while there were not significant differences ($p>0.05$) between Arbor Acer and Cobb500 and Hubbardf15, and between Ross308 and Arbor Acer, (table 4-5) these results might be due to genetic variation among the different breeds, this is the same results found by (Suliaman *et al* 2012) who reported in summer seasons in Sudan that the feed intake were significant difference between Ross and Hubbard, Cobb and Hubbard (generally Hubbard strain has the lowest feed

consumption), but it's not in agree with (Rokonuzzaman *et al* 2015) in winter seasons in Bangladesh of four weeks of age reported that the feed intake were no significant differences ($p>0.05$) among the three strains Cobb500, Hubbard and Arbor Acres, and (Rokon *et al* 2015) reported that in summer seasons in Bangladesh of four weeks of age reported that there were no significant differences ($p>0.05$) among the three strains Cobb500, Hubbard and Arbor Acres.

The differences between four breeds were significant ($p<0.05$) in feed conversion rations which was higher significantly ($p<0.05$) for Cobb500 Compared with (Arbor Acres, Hubbardf15 and Ross308), while there were non-significant differences ($p<0.05$) between Arbor Acres and Hubbardf15 and Ross308, (table 4-5) these results might be due to genetic variation among the different breeds. This is not in agree with (Rokonuzzaman *et al* 2015) who reported that in winter seasons in Bangladesh of four weeks of age the feed conversion ratio of three broiler strains Arbor Acer, Cobb and Hubbard during the first and third weeks showed highly significant ($p<0.05$) differences, but there were non-significant differences ($p>0.05$)in second and fourth weeks of age. Higher and lower were Cobb and Arbor Acer respectively, and (Rokon *et al* 2015) reported that in summer seasons in Bangladesh of four weeks of age the feed conversion ratio of three broiler strains during the first and second weeks showed highly significant differences ($p<0.05$), but there were not significant differences ($P>0.05$) in third and fourth weeks of age. Higher and lower were Cobb and Arbor Acer respectively. But this result not in agree with (Suliaman *et al* 2012) who reported that in summer seasons in Sudan the Feed conversion ratio was

significantly different between Ross and Cobb but there was not significant difference between Ross and Hubbard, Hubbard and Cobb. and Ross strain had higher feed conversion ratio than Cobb and Hubbard strains.

The Mortality rate between four breeds were significantly different between all breeds Arbor Acer, Cobb500, Hubbard f15 and Ross308, Ross308 was higher and Arbor Acer was lower, (table 4-5) these results might be due to genetic variation among the different breeds ability to support diseases in winter. This is not in agree with (Rokon *et al* 2015) who reported that in summer seasons in Bangladesh there were no significant differences ($p>0.05$) of mortality among the three broiler strains Arbor Acer, Cobb and Hubbard at four weeks of age . where (Rokonuzzaman *et al* 2015) reported that in winter seasons in Bangladesh of four weeks of age the Mortality rate of three broiler strains were significant differences ($P<0.05$) of mortality between the Hubbard and Arbor Acres, but there were no significant differences ($p>0.05$)between the Cobb and Arbor Acres.

Carcass characteristics- hot dressing percentage at the end of the five weeks after slaughter As shown in tables 4-6 of the four breeds Arbor Acer, Cobb, Hubbard and Ross there were not significantly different ($p>0.05$) between all breeds. this is not in agree with (Rokonuzzaman *et al* 2015) who reported that in winter seasons in Bangladesh the dressing percentage was highly significant differences between the Cobb-500 and Arbor Acres broiler strains and also highly significant between Hubbard and Arbor Acres. but there were not significant differences ($P>0.05$) between the Cobb-500 and Hubbard. and not in agree with (Rokon *et al* 2015) who reported that in

summer seasons in Bangladesh the dressing percentage was highly significant differences between the Cobb-500 and Hubbard broiler strains and also highly significant between Cobb and Arbor Acres. but there were not significant differences (P>0.05) between the Arbor Acres and Hubbard.

At the end of the five weeks the non-carcass component, as shown in (tables 4-7) revealed that there were non-significant differences (p>0.05) between all breeds in liver, heart, gizzard and abdominal fat but there were significant differences (p<0.05) between all breeds in neck, that was significant differences (p<0.05) between Cobb and Arbor Acer, but was not significant different (p>0.05) between Arbor Acer and Hubbard and Ross, and between Cobb and Hubbard and Ross. This is agree and higher than (Osman.2015) of Arbor Acres breed and (Ali.2015) of Cobb500 breed. But is lower than (Saad.2015) of Cobb500 breed, and (Shareif.2013) and (Mustafa.2014) of Hubbard 15 breed, and (Mohammed.2006) of Ross308 breed.

After slaughter and cooling the Percentage yield of commercial cuts, as shown in (table 4-8) were not significantly different (p>0.05) between all breeds in Percentage of thigh and drumstick, but there were significant differences (p<0.05) between all breeds in Breast. There were significant differences (p<0.05) between in breast Arbor Acer and Ross, and between Cobb and Ross but there were non-significant differences (p>0.05) between Hubbard and Ross, and between Arbor Acer and Cobb and Hubbard. This is not in agree and lower than (Saad.2015) and (Ali.2015) for Cobb and (Mustafa.2014) for Hubbard, (Hamed.2014) and (Elsaeed.2012) for Ross.

After slaughter and cooling the values for meat and bone of thigh and drumstick percentage As shown in (tables 4-9) were not significantly

different ($p>0.05$) between all breeds Arbor Acer, Cobb, Hubbard and Ross, but there were significant differences ($p<0.05$) in meat and bone of breast between Ross and (Cobb, Arbor Acer), and were non-significant differences ($p>0.05$) in meat and bone of breast between Ross and Hubbard, and between Arbor Acer and Cobb and Hubbard. This is not in agree and higher than (Saad.2015) and (Ali.2015) for Cobb and (Hamed.2014) and (Elsaeed.2012) for Ross.

For sensory evaluation as shown in (tables 4-10), there were non-significant differences ($p>0.05$) between all breeds Arbor Acer, Cobb, Hubbard and Ross in flavor, but there were significant differences ($p<0.05$) in all breeds for color, tenderness and juiciness. That there were significant differences ($p<0.05$) in tenderness between Arbor Acer and Cobb and Hubbard, and between Arbor Acer and Cobb and Ross, but were non-significant differences ($p>0.05$) in tenderness between Hubbard and Ross.

There were significant differences ($p<0.05$) in juiciness between Arbor Acer and Hubbard and Cobb, and between Ross and Arbor Acer , but were not significant differences ($p>0.05$) in juiciness between Hubbard and Ross, and between Ross and Cobb.

There were significant differences ($p<0.05$) in Color between Hubbard and (Arbor Acer, Cobb and Ross), but were non-significant differences ($p>0.05$) in color between Arbor Acer and Cobb and Ross. This is not in agree and higher than (Ali.2015) for Cobb, (Shareif.2013) for Hubbard, but was lower than (salih.2015) for Arbor Acres, (Saad.2015) for Cobb, (Mustafa.2014) for Hubbard, and (Hamed.2014) and (Elsaeed.2012) for Ross.

Summary

The objective of this study is to compare between the four broiler breeds Arbor Acer, cob, Hubbard and Ross performance and carcass characters, during the experimental period.

Final body weight were significantly differences ($p<0.05$) between Ross308 and Hubbardf15 breeds but it was not significantly different ($p>0.05$) between Arbor Acer and Cobb500 and Hubbardf15, and between Ross308 and Cobb500 and Arbor Acer, and there were significantly differences ($p<0.05$) between breeds and it's standard.

Feed intake were significantly differences ($p<0.05$ between Ross308 and Hubbardf15and Cobb500breeds while there were non-significant differences ($p>0.05$) between Arbor Acer and Cobb500 and Hubbardf15, and between Ross308 and Arbor Acer., and there were significant differences ($p<0.05$) between the breeds and it's standards.

Feed conversion rations were significantly differences ($p<0.05$) between Cobb and another breeds Arbor Acer, Hubbard f15 and Ross308, and there were significantly differences ($p<0.05$) between breeds and it's standard.

Mortality rate were high significantly differences ($p<0.05$) between breeds of the Arbor Acer, Cobb500, Hubbard f15 and Ross308.

Dressing percentage were not significant different ($p>0.05$) between breeds of the Arbor Acer, Cobb500, Hubbard f15 and Ross308.

Non carcass component percentage of liver, heart, gizzard and abdominal fat were not significant different ($p>0.05$) between breeds of the Arbor Acer,

Cobb500, Hubbard f15 and Ross308, but was significantly differences ($p<0.05$) in percentage of neck.

Percentage of commercial cuts thigh and drumstick were not significant different ($p>0.05$) between breeds of the Arbor Acer, Cobb500, Hubbard f15 and Ross308, but was significantly differences ($p<0.05$) in percentage of Breast.

Meat and bone percentage of commercial cuts thigh and drumstick were not significant different ($p>0.05$) between breeds of the Arbor Acer, Cobb500, Hubbard f15 and Ross308, but was significantly differences ($p<0.05$) in meat and bone percentage of Breast.

The Sensory evaluation of meat were not significant differ in flavor between all breed Arbor Acer, Cobb, Hubbard and Ross, but were significant differences ($p<0.05$) in breeds in color, tenderness and juiciness.

Recommendations

1- More Studies required for commercial broiler breeds under Sudan condition.
2- Study of adaptability to temperature in summer and winter in Sudan.
3- Study of resstens between breeds to diseases in Sudan.

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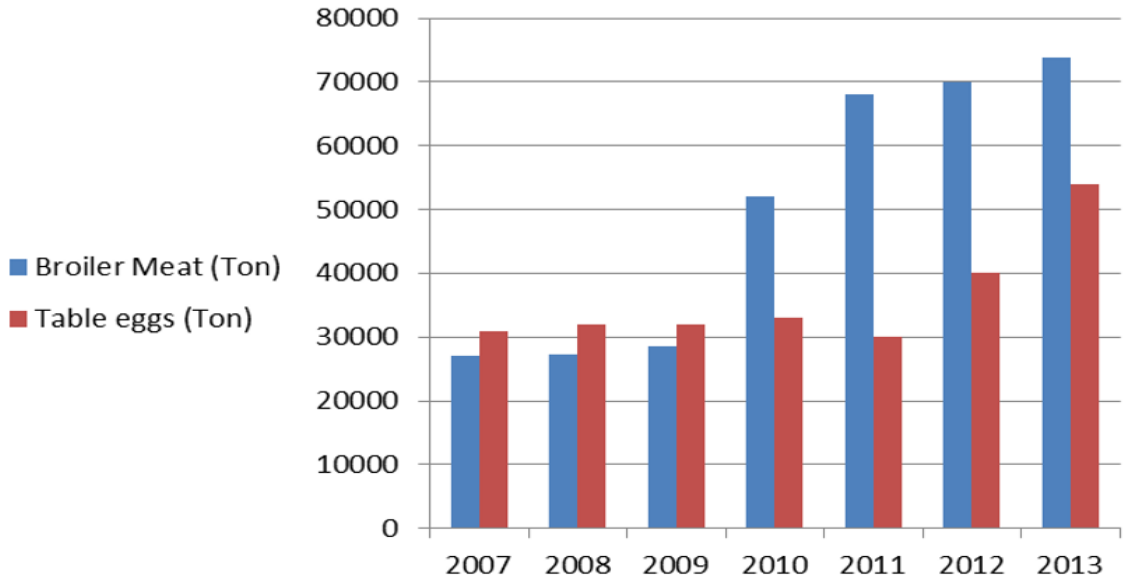
Appendix

Appendix- 1 figure Sudanese annual meat and eggs Production



Appendix- 2 Environmental temperature (°C) during the experiment period

	Min	Max
First week	16	26
Second week	16	26
Third week	16	28
Foust week	18	30
Fifth week	18	30

Appendix- 3 Management Handbook Arbor Acres broilers breeds

Arbor Acres Plus Broiler *As-Hatched Performance*

g

Day	Body Weight (g)[1]	Daily Gain (g)	Av. Daily Gain/Week (g)	Daily Intake (g)	Cum. Intake (g)[2]	FCR[3]
0	42					
1	57	15		14	14	0.246
2	72	15		17	31	0.433
3	89	17		20	51	0.577
4	109	20		24	75	0.688
5	131	22		27	102	0.776
6	156	25		31	132	0.846
7	185	28	20.40	35	167	0.903
8	216	31		39	206	0.951
9	251	35		43	249	0.991
10	289	38		48	296	1.026
11	330	41		53	349	1.057
12	375	45		58	407	1.085
13	423	48		63	470	1.111
14	474	51	41.37	69	539	1.136
15	529	55		74	613	1.159
16	587	58		80	694	1.181
17	648	61		86	780	1.203
18	713	64		92	872	1.224
19	780	67		99	971	1.245
20	850	70		105	1076	1.266
21	923	73	64.06	111	1187	1.286
22	998	75		117	1304	1.306
23	1076	78		123	1427	1.326
24	1156	80		129	1556	1.346
25	1238	82		135	1691	1.366
26	1322	84		141	1832	1.386
27	1408	86		147	1979	1.406
28	1495	87	81.74	152	2131	1.426
29	1584	89		158	2289	1.446
30	1674	90		163	2452	1.465
31	1764	91		168	2621	1.485
32	1856	92		173	2794	1.505
33	1949	93		178	2972	1.525
34	2042	93		183	3155	1.545
35	2136	94	91.52	187	3342	1.565
36	2230	94		191	3533	1.585
37	2324	94		195	3728	1.605
38	2418	94		199	3928	1.624
39	2512	94		203	4131	1.644
40	2606	94		206	4337	1.664
41	2699	94		210	4547	1.684
42	2793	93	93.86	213	4759	1.704
43	2885	93		216	4975	1.724
44	2978	92		218	5193	1.744
45	3069	91		221	5414	1.764
46	3160	91		223	5637	1.784
47	3250	90		225	5863	1.804
48	3339	89		227	6090	1.824
49	3427	88	90.58	229	6319	1.844
50	3514	87		231	6550	1.864
51	3600	86		232	6782	1.884
52	3684	85		233	7015	1.904
53	3768	83		234	7250	1.924
54	3850	82		235	7485	1.944
55	3931	81		236	7721	1.964
56	4010	79	83.32	236	7957	1.984
57	4088	78		237	8194	2.004
58	4164	76		237	8431	2.025
59	4239	75		237	8667	2.045
60	4312	73		236	8903	2.065
61	4384	71		236	9139	2.085
62	4453	70		235	9374	2.105
63	4521	68	73.03	234	9608	2.125
64	4587	66		233	9841	2.145
65	4652	64		232	10072	2.165
66	4714	62		230	10302	2.185
67	4774	60		228	10530	2.206
68	4833	58		226	10757	2.226
69	4889	57		224	10981	2.246
70	4944	55	60.39	222	11203	2.266

[1] On-farm body weight (i.e. feed present in intestinal tract).
[2] Feed consumption per living bird.
[3] FCR includes initial body weight at placement and does not account for mortality.

Appendix- 4 Management Handbook Cobb500 broilers breeds

Cobb500 Broiler Performance & Nutrition Supplement

Performance objectives - metric

AS HATCHED

Age days	Weight for Age	Daily Gain (g)	Average Daily Gain (g)	Cumulative Feed Conversion	Daily Feed Consumption (g)	Cumulative Feed Consumption (g)
0	42					
1	52	10				
2	66	14				
3	81	15				
4	100	19				
5	122	22				
6	148	26				
7	**177**	**29**	**25.3**	**0.847**		**150**
8	208	31	26.0	0.865	30	180
9	242	34	26.9	0.888	35	215
10	279	37	27.9	0.914	40	255
11	320	41	29.1	0.938	45	300
12	364	44	30.3	0.962	50	350
13	410	46	31.5	0.988	55	405
14	**459**	**49**	**32.8**	**1.013**	**60**	**465**
15	511	52	34.1	1.039	66	531
16	567	56	35.4	1.063	72	603
17	626	59	36.8	1.088	78	681
18	688	62	38.2	1.112	84	765
19	753	65	39.6	1.135	90	855
20	821	68	41.1	1.158	96	951
21	**891**	**70**	**42.4**	**1.182**	**102**	**1053**
22	964	73	43.8	1.205	109	1162
23	1039	75	45.2	1.230	116	1278
24	1115	76	46.5	1.257	123	1401
25	1193	78	47.7	1.283	130	1531
26	1272	79	48.9	1.311	137	1668
27	1353	81	50.1	1.339	144	1812
28	**1436**	**83**	**51.3**	**1.367**	**151**	**1963**
29	1521	85	52.4	1.394	158	2121
30	1608	87	53.6	1.422	165	2286
31	1697	89	54.7	1.448	172	2458
32	1788	91	55.9	1.475	179	2637
33	1880	92	57.0	1.502	186	2823
34	1973	93	58.0	1.529	193	3016
35	**2067**	**94**	**59.1**	**1.556**	**200**	**3216**
36	2162	95	60.1	1.581	202	3418
37	2257	95	61.0	1.604	203	3621
38	2352	95	61.9	1.627	205	3826
39	2447	95	62.7	1.648	206	4032
40	2542	95	63.6	1.668	208	4240
41	2637	95	64.3	1.687	209	4449
42	**2732**	**95**	**65.0**	**1.705**	**210**	**4659**

Appendix- 5 Management Handbook Hubbard f15 broilers breeds

Hubbard F15

F15 BROILER GENETIC POTENTIAL / *POTENTIEL GENETIQUE DU BROILER F15*

POTENCIAL GENETICO DE LOS BROILERS F15

Age (days) *Age (jours)* Edad (Días)	**Bodyweight** *Poids vif* Peso neto ♀	♂	**Average** *Moyenne* Promedio	**A.D.G.** *G.M.Q.* A.P.D.	**A.D.G. cumulative** *G.M.Q. cumul* A.P.D. cúmulo	**Feed Consumption** *Cons. d'Aliment* Consumo de Alimento **Day** *Jour* Día	**Cumulative** *Cumulée* Cúmulo	**Feed conversion** *Indice de consommation* Índice de consumo	**Water** *Eau* Agua
0			40						
1			53	13		13	13		23
2			64			15	29		26
3			78			19	47		32
4			95			21	68		35
5			116	15	15	23	91		39
6			139			25	115		42
7			165			28	143		47
8			192			34	177		58
9			224			37	214		63
10			259	29	22	42	256		72
11			297			46	303		79
12			338			53	355		89
13			382			58	413		98
14			429			63	476		107
15	466	498	480	44	29	68	544	1.13	116
16	518	548	533			72	616	1.16	123
17	570	607	588			77	693	1.18	131
18	625	669	647			82	776	1.20	140
19	683	733	708			89	864	1.22	151
20	742	799	770	58	37	93	957	1.24	158
21	802	867	835			99	1 056	1.26	168
22	863	937	900			104	1 160	1.29	177
23	926	1 009	967			113	1 273	1.32	193
24	990	1 082	1 036			117	1 391	1.34	200
25	1 054	1 157	1 106	67	43	122	1 512	1.37	207
26	1 121	1 237	1 179			127	1 639	1.39	215
27	1 189	1 319	1 254			132	1 771	1.41	224
28	1 258	1 401	1 330			136	1 907	1.43	231
29	1 327	1 485	1 406			140	2 047	1.46	238
30	1 398	1 570	1 484	76	48	144	2 191	1.48	245
31	1 470	1 657	1 563			148	2 339	1.50	252
32	1 543	1 745	1 644			152	2 492	1.52	259
33	1 617	1 835	1 726			155	2 646	1.53	263
34	1 693	1 926	1 809			159	2 805	1.55	270
35	1 770	2 019	1 894	82	53	163	2 967	1.57	277
36	1 846	2 111	1 979			167	3 134	1.58	284
37	1 923	2 204	2 064			170	3 304	1.60	289
38	2 000	2 297	2 148			173	3 477	1.62	294

Appendix- 6 Management Handbook Ross308 broilers breeds:

معدلات الاداء لسلالة روص ٣٠٨ - المختلط

العمر	وزن الجسم (جم)	الزيادة في الوزن	إستهلاك العلف اليومي	تراكمي إستهلاك العلف	معامل التحويل	متوسط الزيادة اليومية
٠	٤٢					
١	٥٦	١٤	١٣	١٣	٠.٢٣٧	
٢	٧٢	١٥	١٧	٣٠	٠.٤١٩	
٣	٨٩	١٨	٢٠	٥٠	٠.٥٦١	
٤	١٠٩	٢٠	٢٣	٧٣	٠.٦٧٣	
٥	١٣٢	٢٣	٢٧	١٠٠	٠.٧٦٢	
٦	١٥٧	٢٥	٣١	١٣١	٠.٨٣٤	
٧	١٨٥	٢٨	٣٥	١٦٦	٠.٨٩٣	٢٠.٤٨
٨	٢١٧	٣١	٣٩	٢٠٤	٠.٩٤٢	
٩	٢٥١	٣٥	٤٣	٢٤٧	٠.٩٨٤	
١٠	٢٨٩	٣٨	٤٨	٢٩٥	١.٠٢١	
١١	٣٣٠	٤١	٥٣	٣٤٨	١.٠٥٣	
١٢	٣٧٥	٤٤	٥٨	٤٠٦	١.٠٨٣	
١٣	٤٢٢	٤٨	٦٣	٤٦٩	١.١١٠	
١٤	٤٧٣	٥١	٦٩	٥٣٨	١.١٣٦	٤١.١٢
١٥	٥٢٧	٥٤	٧٤	٦١٢	١.١٦٠	
١٦	٥٨٥	٥٧	٨٠	٦٩٢	١.١٨٣	
١٧	٦٤٥	٦٠	٨٦	٧٧٨	١.٢٠٦	
١٨	٧٠٩	٦٣	٩٢	٨٧٠	١.٢٢٨	
١٩	٧٧٥	٦٦	٩٨	٩٦٨	١.٢٤٩	
٢٠	٨٤٤	٦٩	١٠٤	١٠٧٢	١.٢٧٠	
٢١	٩١٦	٧٢	١١٠	١١٨٢	١.٢٩١	٦٣.١٩
٢٢	٩٩٠	٧٤	١١٦	١٢٩٨	١.٣١٢	
٢٣	١٠٦٦	٧٧	١٢٢	١٤٢١	١.٣٣٢	
٢٤	١١٤٥	٧٩	١٢٨	١٥٤٩	١.٣٥٣	
٢٥	١٢٢٦	٨١	١٣٤	١٦٨٤	١.٣٧٣	
٢٦	١٣٠٩	٨٣	١٤٠	١٨٢٤	١.٣٩٤	
٢٧	١٣٩٣	٨٥	١٤٦	١٩٧٠	١.٤١٤	
٢٨	١٤٧٩	٨٦	١٥٢	٢١٢٢	١.٤٣٤	٨٠.٥٥
٢٩	١٥٦٧	٨٨	١٥٧	٢٢٧٩	١.٤٥٥	
٣٠	١٦٥٦	٨٩	١٦٣	٢٤٤٢	١.٤٧٥	
٣١	١٧٤٦	٩٠	١٦٨	٢٦١٠	١.٤٩٥	
٣٢	١٨٣٦	٩١	١٧٣	٢٧٨٣	١.٥١٥	
٣٣	١٩٢٨	٩٢	١٧٨	٢٩٦١	١.٥٣٦	
٣٤	٢٠٢٠	٩٢	١٨٣	٣١٤٤	١.٥٥٦	
٣٥	٢١١٣	٩٣	١٨٧	٣٣٣١	١.٥٧٦	٩٠.٥٦
٣٦	٢٢٠٧	٩٣	١٩٢	٣٥٢٣	١.٥٩٧	
٣٧	٢٣٠٠	٩٤	١٩٦	٣٧١٩	١.٦١٧	
٣٨	٢٣٩٤	٩٤	٢٠٠	٣٩١٩	١.٦٣٧	
٣٩	٢٤٨٨	٩٤	٢٠٤	٤١٢٣	١.٦٥٨	
٤٠	٢٥٨١	٩٤	٢٠٨	٤٣٣١	١.٦٧٨	
٤١	٢٦٧٥	٩٤	٢١١	٤٥٤٣	١.٦٩٨	
٤٢	٢٧٦٨	٩٣	٢١٥	٤٧٥٧	١.٧١٩	٩٣.٥٧
٤٣	٢٨٦١	٩٣	٢١٨	٤٩٧٥	١.٧٣٩	
٤٤	٢٩٥٤	٩٣	٢٢١	٥١٩٦	١.٧٥٩	
٤٥	٣٠٤٦	٩٢	٢٢٤	٥٤٢٠	١.٧٨٠	
٤٦	٣١٣٧	٩١	٢٢٧	٥٦٤٧	١.٨٠٠	
٤٧	٣٢٢٨	٩١	٢٢٩	٥٨٧٦	١.٨٢٠	
٤٨	٣٣١٨	٩٠	٢٣١	٦١٠٧	١.٨٤١	
٤٩	٣٤٠٧	٨٩	٢٣٣	٦٣٤١	١.٨٦١	٩١.٢٢

Appendix- 7 table means ± SEM of body weight of Arbor Acres breed

Item	W1	W2	W3	W4	W5
A_{st}	185a	474a	923a	1495a	2136a
A	138.32±1.16b	437.9±1.18b	914.5±4.92a	1496.6±15.27a	2161±19.11a

Appendix- 8 table means ± SEM of feed intake of Arbor Acres breed:

Items	W1	W2	W3	W4	W5
A_{st}	167a	539a	1187b	2131b	3342b
A	110.5b	491.8±.004b	1260.7±7.13a	2245.4±39.19a	3429.1±32.53a

Appendix- 9 table means ± SEM of Feed conversion rations of Arbor Acres breed:

Items	W1	W2	W3	W4	W5
A_{st}	0.903a	1.137a	1.286b	1.425b	1.565a
A	0.799±.006b	1.123±.007a	1.378±.004a	1.5±0.032a	1.587±.016a

Appendix- 10 table means ± SEM of body weight of Cobb500breed

Items	W1	W2	W3	W4	W5
C_{st}	177a	409b	891b	1436a	2067a
C	166.3±2.12 b	419.5±5.39 a	923±12.65 a	1511.7±44.4 6	2135.1±84.03 a

Appendix- 11 table means ± SEM of feed intake of cobb500 breed

Items	W1	W2	W3	W4	W5
C_{st}	150a	465b	1053b	1963b	3216a
C	125a	533.8±7.14a	1259.9±13.99a	2239.3±67,7a	3210.9±123.88a

Appendix- 12 table means ± SEM of Feed conversion rations of Cobb500 breed

Items	W1	W2	W3	W4	W5
C_{st}	0.847a	1.013b	1.182b	1.367b	1.556a
C	0.752±.009b	1.113±.009a	1.364±.013a	1.481±.01a	1.504±.026a

Appendix- 13 table means ± SEM of body weight of Hubbard f15 breed :

Items	W1	W2	W3	W4	W5
H_{st}	165a	480a	835b	1330b	1894b
H	144.7±1.59b	454.84±7.06b	930.7±8.15a	1452.3±14.06a	2065±22.58a

Appendix- 14 table means ± SEM of feed intake of Hubbard f15 breed:

Items	W1	W2	W3	W4	W5
H_{st}	143a	544a	1056b	1907b	2967b
H	105a	528.7±5.89b	1303±9.78a	2200±17.42a	3348±37.53a

Appendix- 15 table means ± SEM of Feed conversion rations of Hubbard f15 breed

Items	W1	W2	W3	W4	W5
H_{st}	0.867a	1.133a	1.265b	1.434b	1.567b
H	0.73±.007	1.164±.004a	1.401±.018a	1.514±.01a	1.621±.005a

Appendix- 16 table means ± SEM of body weight of Ross308 breed

Items	W1	W2	W3	W4	W5
R_{st}	185a	473a	916b	1479b	2113b
R	150.2±1.4b	472.3±8.21a	988.9±10.82a	1669.9±19.87a	2318.8±24.81a

Appendix- 17 table means ± SEM of feed intake of Ross308 breed:

Items	W1	W2	W3	W4	W5
R_{st}	166a	538a	1182b	2122b	3331b
R	110a	537.3±6.42a	1355.9±23.92a	2460.3±41.79a	3670.5±64.87a

Appendix- 18 table means ± SEM of feed conversion rations of Ross308 breed:

Items	W1	W2	W3	W4	W5
R_{st}	0.897a	1.137a	1.29b	1.435b	1.576a
R	0.732±.006b	1.138±.007a	1.37±.013a	1.473±.011a	1.582±.018a

Appendix- 19 table means ± SEM of body weight of breed:

Items	W1	W2	W3	W4	W5
A	138.32±1.16c	437.9±2.18b	914.5±4.92b	1496.6±15.27b	2161±19.11ab
C	166.3±2.12a	479.5±5.39a	923±12.65b	1511.7±44.46b	2135.6±84.03ab
H	144.74±1.59bc	454.8±7.06ab	930.7±8.15b	1452.3±14.06b	2065±22.58b
R	150.2±1.4b	472.3±8.21a	988.9±10.82a	1669.9±19.87a	2318.8±24.81a

Appendix- 20 table means ± SEM of feed intake of breed:

Items	W1	W2	W3	W4	W5
A	110.5b	491.8±2.89b	1260.7±7.13b	2245.4±39.19b	3429.1±32.53ab
C	125a	533.8±7.14a	1259.9±13.99b	2239.3±67.7b	3210.9±123.88b
H	105d	528.7±5.89a	1303±9.78ab	2199.5±17.42b	3394.1±37.53b
R	110c	537.3±6.42a	1355±23.92a	2460.3±41.79a	3670.5±64.87a

Appendix- 21 table means ± SEM of Feed conversion rations of breed

Items	W1	W2	W3	W4	W5
A	0.799±.006a	1.123±.007a	1.378±.004a	1.5±.32a	1.587±.016a
C	0.752±.009b	1.113±.009a	1.364±.013a	1.481±.01a	1.504±.026b
H	0.73±.007b	1.16±.004a	1.401±.018a	1.514±.01a	1.621±.005a
R	0.732±.006b	1.138±.007a	1.37±.013a	1.473±.011a	1.582±.018a

Appendix- 22 Photoshop experiment

Chick in weekly weight

Commercial cuts: