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Comparison of chickens' performance under backyard and free-range systems of rearing in Nigeria

MASTER'S THESIS

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Declaration

I hereby declare that I have done this thesis entitled **"Comparison of chickens' performance under backyard and free-range system of rearing in Nigeria *(Gallus domesticus*)"** independently. All texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In Prague, 2020

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Adamu Usman Jauro

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Abstract

Birds are an important source of protein for humans, with a growing demand for cheap and affordable sources of protein in Nigeria, where is the need to device ways of growing chicken in a more affordable way. The present study was design to evaluate the influence of backyard and free-range system of rearing on growth performance, blood performance and carcass traits of Nigeria indigenous chicken. A total number of 80 birds randomly divided in to two groups (free range system of rearing and backyard system of rearing) were used for the study over a period of 12 weeks. The birds were first subjected to adaptation period for two weeks. The birds were given same feed and management. The body weight was not significantly ($p>0.05$) influenced by the rearing systems at week 0, 2, 3 and 5 week. However, at week 1 and week 6 to 12 the backyard system of rearing significantly produced more weight. Weight gain and average feed intake was however, enhanced under free-range management for most of the weeks of observation. Backyard system of rearing also significantly ($p<0.001$) performed better in terms of most blood samples except for haemoglobin, PVC and RBC. Similarly on carcass, Backyard system of rearing also significantly ($p<0.001$) performed better as compared to free-range on most parameters from Mann-Whitney test. From the result obtained in this study, rearing the birds under backyard system seems to be more promising on the overall performance of the bird. Raising the chicken under backyard system of rearing management improved their growth and performance.

Key words: Blood, Carcass, Performance, Rearing, Weight.

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List of the abbreviations used in the thesis

abd.fat	Abdominal fat
AV.W.FI	Average week feed intake
Creat	Creatinine
D. percentages	Dressing percentages
D. stick	Dressing stick
d.weight	Dressing weight
Hb	Haemoglobin
NIC	Nigerian indigenous chicken
prev	Previnticulus
PVC	Park volume cell
RBC	Red blood cell
WBC	White blood cell

1. Introduction and Literature Review

1.1. Introduction

Poultry plays a role in to the livelihoods as well as food security for billions people living in the world, it also contributes to the diet and health of many people in the world. There are about 1.43 billion cattle, 1.87 billion sheep and goats, 0.98 billion pigs, and 19.60 billion chickens in the world, with these facts, the chicken population is statistically ranking the number one populated specie in the world (FAO 2006). Poultry production has become a significant aspect in the global perspectives, due to the incessant growing demand for poultry meat as well as rapid increase in population (FAO 2006). Chicken meat plays a role in overcoming the shortage protein across the world, this occurred due to global engagement in the part of chickens rearing. (Sulistyoningsih et al. 2013) reports that Indigenous chicken are local chicken that are frequently consumes by a particular community and usually have heterogeneous character. Historically, Indigenous chickens are originally from jungle fowl, and are regard as warm-blooded animals because of their ability to regulate their body temperature (Iswanto 2008).

Africa is one of the largest continents in the world, with an estimates population of about 1.2 billion, and 66.4 per cent of rural dwellers (FAO 2006). The African chicken population estimated to be 1.068 billion, the livestock population of Africa, statistically showed that poultry is the most numerous species of farm animals across the continents (Gueye 2000). The local breed of African chickens distinguished from other chickens in all part of the world, this is because of their ability to withstand a stress and their capability to adapt wide range of different climatic conditions (Gueye 2000).

Nigeria is part of Africa from the west, with estimates population of more than 150 million of poultry, (FAO 2006). Nigerian Indigenous Chickens (NIC) (*Gallus domesticus*) constitutes about 80 percent of the 166 million poultry birds across the nation (FAO 2007). (FAO 2001) and (Adene 2004), reports that NIC exhibit large variation in body size, plumage colours, feathering pattern, eggshell, ear lobe and shank colour, in addition, it's also reports that at the initial of the production, NIC requires low capital

investment when compared with non-indigenous breed of chicken and they are not having any religious or social taboos, hence the products do not need storage or preservation facilities for family consumption (Adene 2004), because the size of the bird is essential for meal, and their meat and eggs are preferred widely by consumers because of the taste, leanness, texture, etc. (FAO 2001) and (Adene 2004).

The poultry industry in Nigeria has witnessed expansion in recent times; this expansion has a positive relation with the increase population of the poultry across the nation (FAO 2006). The NIC breed is considered as the most important poultry species, in terms of number and rate of investment in poultry production (FAO 2006). NIC are raised in all parts of Nigeria and their meat and eggs have continued to be the major source of animal protein for the rapidly growing Nigerian population (Zahraddeen et al. 2010). NIC has the potential to provide affordable animal protein to the rural populace and improve their nutritional status, which has a great advantage in creating both rural and urban employment (Paul & Islam 2001). It was reported that NIC contribute more than 80 per cent of the total poultry meat consumes in the country of which only local scavenging chicken contribute about almost the 80 percent (Paul & Islam 2001). Similar to other breeds of chicken, NIC has a flexible growth pattern, however the level of output and growth is in free-range system of production compare to that intensive system of production (Nowsu 1979), and again, in terms of adaptation to the tropics and resistant to poor handling, the free range system of rearing also has great advantage than backyard system of rearing (Oluyemi et al. 1979).

1.2. Literature Review

1.2.1. Nigerian indigenous chickens

1.2.1.1. Basic systems of rearing chicken in Nigeria

The rearing of chicken (*Gallus domesticus*) it's now globally considered as generally acceptable when over view the fact that the rearing is dominating almost everywhere in Nigeria, Africa, and the entire world at large (Pagani et al. 2008). Nigeria is among the African countries that are facing problems of conventional feeding, appropriate health care, and comprehensive information on the poultry production sector, most especially on the indigenous chickens, and this is because 99.27% of the chicken in the country are reared under non-improved system of management (Zainudin 2005). Report shows that the free-range system is dominating the other systems, this is because many poultry productions in Africa are based in the rural and semi-rural areas, where birds are reared in small number that have access for moving freely as scavengers without feed supplementation (Mcainsh et al 2004). In this regard, the production is broadly divided in to large-scale and smallholders chicken production, the small-holders production are regularly women from rural areas. Thus, this type of rearing system is practiced in the area with less population (Mcainsh et al. 2004). Nowadays, the high need for consumers to produced foods on their own have progressively increased, and this habit has manifest not only in Africa, rather, is all over the world. For instance, in Europe parts, consumers can accept to pay higher prices to purchase organically grown animal products (Bennet 1996), this highly demanded of original animal product is trigger out the practicing of rearing chickens under free range system (Fantiaco 2005). Research shows that women are taking care of most of the chickens flocks in the rural area (Adegbola 1988); this strongly shows that majority of the management activities for chicken rearing are done by women while men are the lion share in terms of crop cultivation and other farm daily duties (Halima et al. 2007).

Free- range chickens are raised mainly for meat purpose as number one priority, where egg provision serves as additional advantage. Mostly the meat and egg are used for household consumption, but in some rare occasions serves as urgent source of

income and some socio-cultural obligations, such as welcoming of guess, spiritual sacrifice, gift, etc. (Nwagu 2002), regularly, the flocks are not more than 30 adult birds per each individual household, with less or even no supplementation of feed items to the birds, which of course the birds have to vacate from their temporary night shelter in the early morning just to search for any edible object around the house (Njenga 2005). Some of the feed resources eaten by free-range chickens are: grass, insects, worms and various seeds (Birech et al. 2002), but when it is at the time of crops harvesting, chickens are fortunately restricted from being going out of the house in which the householder can supplied them with crops residue, and a little supplementation of grains, such as millet, guinea corn, maize among other, while in the night chicken are going back to their temporary night shelters, and some of such night shelters used by free range chicken in the village are: kitchen, corridor, garage, rudimentary coops, etc. (Birech et al. 2002), hence farmers are using such materials as a result of poverty harassment to the majority of the farmers, and of course this serves as one of the problem that aids birds to poor management that could always yield a none fruitful result to their performance (Birech et al. 2002). Indigenous chicken are considered as not profitable for business from the other point of view, and this view has a good association with low productivity and high mortality rate (Das et al. 2008). Report shows that some few changes occur in modern rearing that attached with conventional feeding system could promote the level of productivity in indigenous chickens (Das et al. 2008). Traditionally Indigenous chicken reared for twenty weeks could weighted only 746 g under free range system of rearing, while in backyard rearing can weighed up to 1435 g, with improved management, and these wide gap between the two systems of rearing would be as result of environment which leads to some changes, such as respiration, perspiration, and even the body temperature of the chicken (Isroli 1996).

Backyard system of rearing just like its counterpart also plays a role in meat and egg production in Nigeria (Paul et al. 2003). However, there are some of the producers that prefer to raise a none- indigenous breed (red island) than the local one, but still majority of farmers are engaged in the production of indigenous breeds (shika brown and naira white), because almost every house hold, can raise about 6 to 12 or even more

individuals of local chicken at front and/or backyard of his house (Paul et al. 2003). It is clearly indicated that backyard system of poultry production regarded as reasonable profitable ventures, especially in urban and semi-urban areas where people can able to afford new technical input (feed, vaccines, electricity) and output (product and market) facilities due to accessibility of such items around their destination (Mekasuwa et al. 2011). (Zainudin 2005) reported that breeding pattern of indigenous chicken in free range system of rearing in the villages is more extensive than backyard system of rearing, because some research showed that chicken performance is better in backyard where chicken have cages and henhouses for the comfort and protection against disaster, so that feed consumed by the chickens can be utilized at optimal level for growth. Regularly the size of the flock in backyard ranges from 5-500 adult birds, depending on the objectives of the rearing (Kingori et al. 2010). In this regard, unlike in free-range counterpart the birds are fully confined, without any means of movement rather than within their houses which is fully constructed with adequate facilities made from industry or hand, the chicken in this system are provided with conventional feed made by company or hand, although in some few occasion there is supplementations of kitchen waste and vegetable (Kingori et al. 2010). In terms of health care delivery there is a little progress in this system of rearing, this is because majority of the owners have a good collaboration with the veterinary person(s), where they can call the attention of them at any emergency needs. In terms of housing, backyard system of rearing does not backup with temporary shelters like free-range, here the deep litter and slatted floors are the most common used in most of the urban part of the country, even though there are some producers that can raised their chicken in battery cage (Kingori et al. 2010). Partially the birds can be raised for household consumption, but regularly are for commercial purposed, that is why the system does not have a single purpose considering the facts that apart from meat target, there is also advantage of egg provision by the chicken as well as rapid growth and less casualties than free range (Okeno et al. 2012). Research shows that some of the farmers are now practicing this system in the villages, because of the expenses of the production input in the urban area, which have direct influence with production cost in rearing of the birds (Menge et al. 2005). When we turn in to welfare of the animal, it clearly indicates that backyard system of rearing does not

contribute essential welfare of the animals, this is because the NIC are naturally scavenge birds, which are already used to free movement and exhibit their natural behaviour, but when they are totally confined, this really make them to be more stressed (Jones&Millis 1999), and subsequently resulting to physiological and behavioural responses of the birds (Marin et al. 2001). (Mendl 1999) confirmed that animal total confinement can even have a negative feedback for their general performance, so changes in the rearing system, or pattern that can eliminate or reduce the abnormalities of the birds will subsequently give a chance for birds comfort which is one of the great task for the producers, thus, this can be done by selection of strains that can help towards the achievement of good welfare and comfort of the birds. Moreover, there is a need for new approach that can involve the Ministry of Agriculture from different countries to implement legal policies concerning the criteria for the production, rearing systems and pattern, along with welfare of the birds (Santos et al. 2005). However, apart from welfare and rearing pattern, there should be other considered factors which included the nutrition, climate, and sex of the bird, because these factors can be directly or indirectly influence the system of rearing (Silva & Nakano 1998). The potentiality of backyard chicken production in Nigeria goes with the fact that it utilizes excess family labour, and women are actively involved in benefiting the real dividend of gained obtained in the production (Okere et al. 2015). Basically, the local chickens in Nigeria are triple purposed (meat, brooding, and hatching), this is because they have capability of hatch and raise chicks, and meat production as well, this hatchability efficiency is great advantage to the local chicken of Nigeria due to the absence of incubators of which most of the farmers cannot afford, the hatched chicks are also fed, protected and raised by their mothers (maternal instinct) (Okere et al. 2015), this strong maternal instinct serves as brooding tools, and clear indications of good hens and trait. However, in terms of profitability and economics perspectives, these considered as achievement of poultry production as commercially gained momentum, because recently it is estimated that the contribution of poultry meat across the world as animal protein for human diet increased from 14% in 1977 to 23% in 1987 and is further estimated to 30% in1997, and still progressively increase up to date (Paul & Islam 2001).

The semi-intensive system is among the three basics systems of NIC production, its intermediate system between the free range and backyard system of rearing, in this system the birds are provide with shelters and feeds but move freely and scavenging in part of their day time (Paul &Islam 2001). However, in this rearing type, chickens are raised in small number, mostly 5 to 50, and the purposed for rearing is for house consumption and sometimes sold where there is need for urgent cash, inputs used in this regard, is range from low to medium depending on the commercial demand of the flock within a particular location (King'ori et al. 2010). The shelter is provided to the chickens but not in adequate manner, this system can be practiced in both rural and urban areas (King'ori et al. 2010).

1.2.1.2. The role of Nigerian NIC

The important of NIC cannot be emphasized, because of their vital roles plays to both rural and urban people, with these facts, they can considered as living banks for steady capital treasure, and interest accumulated medium earned by the farmers (Singh 1990). NIC provides reasonable income and reliable source of considerable capital for financing other agricultural investments as well as nutritional secured tools during periods of adverse climatic fluctuation (Odubote 2015). The NIC are harder than non-indigenous (exotic) breed of broiler and the taste, flavour, and juiciness of their meat are almost similar to the non-indigenous cockerel, but NIC differs in some vital parameters, example, the water contains is up to 56%, and calories is 320 for 100g of meat energy, whereas its about 71% water and 151 calories for non-indigenous broiler (Singh 1990). Many research shows that there is a great controversy on right purpose for rising NIC despite the facts that farmers believe that NIC are less susceptible to diseases compared to improved broiler strains (Sil et al. 2002), it is also observed that the poor response of NIC to selection for improving body weight, aided the breed not to be considered as potential broiler strain, therefore, it is obviously concluded that the breed could fit for light egg strain (Oluyemi 1974). However, (Nwosu 1990), noted that the NIC shows reasonable hybrid vigour when crossbred with improved breeds, this contributed in making a suggestion that NIC could be used to develop an egg-type chicken (Oluyemi

1974). The contributions of NIC to owner food security in majority parts of the third world is a recognisable aspect, why because it serve as sustainable investment especially in the rural community, which regard as strong security for the keeper due to the highly liquidity potentials that the NIC possess (Mwacharu et al. 2007). Other purposes for raising NIC includes status and respect giving to the owner, tenderness and juiciness of the meat, it does not have any religious taboos associated with its consumption and it is a good sources of white meat, which has less cholesterol (Ironkwe & Ameafula 2008). However, despite all these recommended advantages, but most of the chicken producers in Nigeria are liable to stop the business, due to poor management practices, inadequate running capital, rising cost of feed which sometimes accounts for about 65 to75% of the total cost of production (Olomu 2011).

1.2.1.3. General Appearance of NIC

Like other breed of chickens, NIC also varies in their shape, size, colour, and even in their feathering, and these differences are going simultaneously with the geographical locations of the birds, in addition, the nature of the tropical environmental factors also aids the influence of appearance on domestic birds (Halima et al. 2007). For example, the chickens from northern part of Nigeria are different from those in the southern part of the country, similarly, the chicken of Mambila town of Taraba state of Nigeria are clearly distinguished from all other chickens of the country in terms of body size, because they are very large in size (Eshiett et al. 1989). NIC have many colours, and the major ones varies from red, black, white, brown to multi- colour chickens, and in terms of body weight the average weight is range from 1.0 kg or even less, to 2.0 kg at maturity, although there is evidences that nullified this facts (Akinokun et al. 1979). Apart from low mature body weight, NIC are also characterized by some survival traits such as hardiness, slow growth, small body size, tolerance to prevalence diseases organisms as well as parasites (Ibe 1990). In terms of maturity the NIC have early sexual maturity than other improved breed, good fertility as well as capability for hatchability. In terms of the egg produced by NIC in most cases are in small number and size, and white in colour shelled eggs but the production interval is short (Oluyemi& Roberts 1979). They are also known

as brooding mothers, because of the exhibition of strong maternal instinct from the mother towards her chicks especially in the presence of rain fall or when the predators tend to attack her chicks, but with regard to the comparison between birds or among the flocks the local chickens are to be considered as unpredicted birds, due to lack of tentative direction in their performance, because there is no genetic classification made so far, so also the same constraint are engaged with the genotype and breed (Oluyemi& Roberts 1979), this unrealistic character is described by FAO (2004) on characterization of animal, which they made a clear definition of the genetic attributes of animal species or breed that has unique identity and the environment to which the species or breed populations are adapted.

The genetic of NIC is the back born for their variations, however, Information about their genetic resource is very rare to the extent that urgent need for precaution measures against the extinction of the viable parent stock have to put in to serious consideration (Sonaiya & Olori 1992), otherwise the breed would keep on going with a lot of deficiencies, however, there have been some efforts at characterizing the NIC which involve classification based on location. For example (Sonaiya & Olori 1992) noted two ecotypes characterized as forest and savannah (Yoruba) and Fulani ecotypes respectively. (Nwosu1979), also made an effort on three main strains in ecotypes, named Nsukka, Owerri, and Awgu types in the South-east of the country. Recently (Fayeye et al. 2005 & Momoh et al. 2007) also gave their contribution, which showed that the ecotypes variations are broadly divided in to two major categories on the basis of body size and body weight of the birds (heavy and light ecotype). The heavy ecotype is the one that is dominating the Guinea and Sahel Savannah region, whereas the light one is found in the swamp with the weight of 0.68 to 1.50kg at maturity, this implies that the weight of the NIC found around the mountain region of the northern part of the country is different from these in the rain forest (Faye 2008).

Heat regulation: this is another unique character of NIC, because of the lack of possession a functional sweat-gland, therefore, NIC regulates no matter how the amount of ambient temperature, matured NIC can maintain the body temperature at about 41 to 42 C° or even more, however the best ambient temperature for chicken is between 15 and 25 C° (Halima et al. 2007), anything above or below these temperature leads to more

or less stress to the function of the mechanism for heat regulation, that's why when the ambient temperature is extremely low, the birds would be shaking their feathers out, but small chickens does not have ability to regulate their body temperature, therefore extremely low temperature may caused mortality in their flock (Halima et al.2007).

De-feathering: This is the technical method of reduction feather from the birds, de-feathering of NIC help in controlling the birds from being flying from one replicate to another, and the advantage of this is that there is not provision of any negative effect to the growth and development of the birds, for instance, the superiority of bare-neck indigenous chickens over two other Sudanese local fowls in terms of live weight has positive relation with de-feathering of the bird (Mohammed et al. 2005), and again in terms of successful conducting of research, when feather are removed, it make easier for restricting the bird from being flying from their allocated replicate to one another.

1.2.1.4. Adaptation of NIC

Indigenous chickens are types of birds that have very high adaptation capacity most especially those reared as free range, due to their adaptation to the range of their local environment (Walley et al. 2015). There is a unique and special adaptive behaviour of NIC that predisposing them to adapt their local environment, and this behaviour has been reported by several researchers (Adebambo et al. 1999). NIC are also known for their adaptation superiority with respect to high resistance to endemic diseases and other hash environmental conditions that could possibly result an adverse effect to non-indigenous one (Nwakpu et al. 1999). But in terms of gene adaptation, the local birds, especially in villages may occasionally crossed with improved cocks through the cockerel exchange program, but in most cases such gene may not survive, and eventually lost in the population because of less adaptation capacity to the gene as well as absence of selection (Njue et al. 2002). In terms of feeding adaptation, unlike other chickens, NIC have potentiality to overcome the problem engage with sudden change of diet, that can result digestibility disorder, although there is little stress concerning the feed changed to NIC (Adebambo 2011) but the stress is not affect the general performance of the bird. Reports shows that non-indigenous breed of chicken have the ability to produce higher number of eggs and more meat than NIC, but in terms of stressful adaptations, they cannot adapt it like in purebred of NIC, therefore to improve the feed adaptation there will be need for cross breeding (Adebambo 2011).

Indigenous chickens of any country are good adapted to the locally supply of conventional and non- conventional feed stuff of their respective locality, more resistant to local pests, parasites and diseases than improve one, for instance in Nigeria, research on indigenous chickens has gradually increased recently, especially on comparative studies of their growth and reproduction rather than adaptation (Adebambo 2004; Yakubu et al. 2009; Peters et al. 2010). However, selection in local breeds has been targeted more at adaptation to harsh environments and resistance to diseases rather than enhanced production (Minga et al. 2004).

1.2.1.5. Feeding behaviour of NIC

NIC are birds that have special behaviour in their feeding system, a typical feeding behaviour of NIC can be easily observed in the free range of rearing system, because in this system the chickens have the capability to move and even run to search for feed themselves, because naturally NIC are live to search for their own food within the homesteads and around crop-fields during daytime, but in the night, they can stay in shelters or in the houses with the household members for the reason of security (Kitalyi 1998). NIC have a great competition within them-selves during feeding regime, they even exhibit strong cannibalism behaviour, as fittest of the survival or as first come first serve. However, in some extensive systems, the birds can hang around the kitchens or in tree branches as their night shelter (Kitalyi 1998). Free-range chicken obtained their diets from bye-product resources, which is the major nutritional input in a free-range system and involve in searching for household materials or left-over and even environmental feed materials as the secondary sources of food to the extent that only amount obtained in this regard constitute more than 60% of the total feed consumed in a day (Kitalyi 1998), but the limitations is that the availability is not all year round, because of the variation in cropping patterns and house hold consumption habits (Roberts 1999), other sources of the variation is from the life span of insects and other invertebrates across the chickens homesteads, and environment which include the seasons of farming activities (Sonaiya 2004). Its reported that free range system of rearing having a less chance of consuming more feed than backyard system of rearing, and this is because chicken are birds that can eat more when they are not in crowd, chicken that are close to each other or close to any means of sounds such as drums or any relevant sound can be eat less (Barber 2001), However, genetically NIC have less feed consumption, when compared them with commercial or non-indigenous one, although research showed that rearing non-indigenous mixed with NIC can trigger the level of consumption to be high (Iyasere et al. 2018).

1.2.1.6. Social behaviour of NIC

Similar to other breed of chickens, the social behaviour of NIC start from embryonic stage, and this behaviour begin at chick stage (Versace et al 2015), however, environmental stimulation has a great effect on developing such behaviour, where the neurochemistry of development and memory formation in the post hatching period also contributed in the developing the behaviour (Versace et al 2015). There is a transitions of behaviour which occur in the first 2 to 3 weeks after hatching, in this period the hen could have a strategic alarm use to unite her chicks, especially when are far away from her (Christopher et al. 1998). Similarly the chicks also have their own strategic alarm that shows to their mother if they need her help, especially in the presence of predators, NIC are birds that have capability of recognition their house hold, they can exhibit some behaviours that bring signal to the owner when the need food, or special assistance, (Christopher et al. 1998). However, in a situation of mating the cock have a strategic behaviour that he uses to demonstrate toward the hen, which signify the hen, and subsequently arouse her sexually, the cock usually produce characteristic 'food' calls upon discovering edible object, and are doing so in the presence of a hen (Christopher et al. 1998). However, the hen behaviour is not mediated as that of cock; she can predict the presence of food by social information, such as a low level of aggressiveness from the cock (Christopher et al. 1998). Hens responded to food call, plays back by fixating downwards, this movement style is specific only to food calls and did not occur in either of the control condition (Christopher et al. 1998). Observations prove that production of food calls have functional consequences (Macedonial 1990). Intensive backyard system of rearing has a low influence in respond to poultry social behaviour (Marchewka et al. 2013), and this is because of the setback associated with the effects of the size of the group, density, or both the two which are eventually affecting the welfare of the birds as result of insufficient space, and rampant injuries especially wing breakages between birds in their houses, and hence increase the level of aggressiveness which of course is low or even absent in extensive system of rearing (Sherwin & Kelland 1998).

1.2.1.7. Breeds of NIC

There are more than 300 breeds of chickens in the world, most of them are considered as local breed (Gietema 2005), In Nigeria there are many breeds, among which are Red island red, Sussex, Leghorn, Yoruba, Fulani, Nera-White, Nera-Black, Kuloilers, Oravka, Naked-neck, Giri, Nana etc. Commercially the NIC breeds can be broadly divided into three groups, thus include: egg type (Gietema 2005), the most important and popularly known representative of this group is white Leghorn, which having characteristics of high production of egg, shortage broodiness and low feed consumption, other breeds are meat, and dual purpose type, which include near-white, among other (Gietema 2005).

1.2.2. Housing of chicken

Housing is very important factor in NIC productions, an ideal housing structure should have its two long side walls built up to 2.0 to 3.0 meter from the ground and the rest of the walls fixed with either chicken wire mesh or sticks for good ventilation (Halima et al. 2007). An ideal structure of the house has to be in the direction of north-west so as to avoid excessive in coming of rainfall and wind (Halima et al. 2007), but this ideal house is not used by all farmers, because majority of them cannot afford to build the house, this is the reason why many farmers provided only night shelter for their chicken (Halima et al. 2007), however, there are even some that kept their chicken in part of the kitchen, and surprisingly these farmers can reach 1.36%, there are about 39.07% that are kept their own in the main house, where about 7.29% kept in hand-woven baskets, and 1.51% in bamboo cages, or in a separate shed purpose-made (Halima et al. 2007). The type of cage is another type of housing used in rearing chicken. However, the flooring is one of the environmental factor influenced the productivity of the chicken; there are 2 types of cage flooring; mainly the litter and distantly space flooring (Widjastuti et al. 2005). Litter flooring is affecting the feed intake on chickens (Mugiyono 2001), therefore, there are some criteria to be observed in preparing good litter materials, these included the availability of the material, absorber capacity of the material, the material have to be

free from dirt, dust, and poison, and easy to clean. Litter cages has the advantages of protection against the cold and moisture of the floor, however dump litter can increase microbial activity and ammonia on the floor that can cause discomfort of the chickens (Sulistyoningsih et al. 2013).

The free-range housing system has become integral part of poultry production (Dawkins et al. 2003), chicken can stay long time for scavenging so as to have great advantage for free moving and welfare, therefore, the level of productivity and output can be achieved if this system is improved with modern housing equipment, however, there is disadvantage of this system which is the avian influenza (Castellini 2005), this is reason why in some instances, chicken reared under backyard and free-range respectively have shown a difference (Farmer et al. 1997). But on the other hand, the backyard housing system, unlike free range counterpart lead to chicken stress and result poor performance, therefore the alternate way to avoid the stress of the chicken is semi-intensive system, because the chickens are reared in their house and have access to a pasture area during the day (Barbosa Filho & Lima 2005).

1.2.3. Environmental effects on chicken

Many reports has showed that Poultry production has undergone enormous changes most especially during the period of last decade, and this dynamic changes is still continue up to date, for instance, in the zone of this research, that is the northern guinea savannah zone of Nigeria which is located between latitude 11◦N, 12 N and longitude 7◦E, 8 E, at an elevation of 650 m above the sea level, the zone has average temperatures of 39.8±3.2◦C and 18.0±3.7◦C as minimum and maximum temperature respectively (Halima et al. 2007). The monthly average rainfall during the rainy season is 148 ± 68.4 mm, while the relative humidity obtained monthly is 71.1±9.7% (Halima et al. 2007). The zone is characterized by three regular seasons, these included Harmattan, hot and dry, and rainy season (Halima et al. 2007), the number one important environmental factor towards sufficient chickens production is temperature, which is rise above 30 C° in raining season (Halima et al. 2007), especially at the onset of the season which is eventually affect the birds consumption of feed, and drastically reduces egg production

and weight, and this scenario could be observed when temperature is between 34.6C° - 37.0 C° and more (Jimoh 2003). NIC are birds that have a great influence to environment, most especially those reared under free-range system due to their direct access to the natural environment. However, some researchers report that the environmental changes may affect free-range or backyard system of rearing, depending on the extent of climatic variations (Halima et al. 2007), hence the influence on environmental change, such as dry and or winter season have negative impact on the general performance of chicken(Halima et al. 2007). Apart from the effect of temperature, relative humidity, light, rain fall, are among the considerate environmental factors in production of chicken, and the most considerable aspect in this regard is to measure, understand, and strategically determine how does the increase in body mass of birds appears, so as to control and modify the external atmospheric conditions that affect the weight gained by the chicken (Oliveira et al. 2000 & Agudelo Gómez et al. 2008). Ventilation also contributed a lot to the welfare of the chickens, to the extent that any disaster that can have a chance to alter the optimum requirement of ventilation, would be possibly subject the chicken to death. Environmental factors can also affect the production performance such as egg production, which directly affect the performances of feed utilization of saturated and unsaturated fatty acids (Harms et al. 1982). Heavy rain fall have direct influence to young chickens in Nigeria, especially at the age of four to seven weeks, due to the lack of maternal extinct from the mother and absence of thermo-regulation ability, because at that period the chickens are neither developed the capacity for the regulation nor withstand hash condition, therefore the chickens can be only exhibits their good performance in the afternoon time, because during that time the atmospheric condition is sunny, and this is the reason why better productivity of chickens is strongly have correlation with the specific location and shelter provision for the birds (Halima et al. 2007), for instance the effect of roofing, which ultimately affect the production, because the intensive level of the sun heat which can raised up to 6.5 - 7.7 hours daily, therefore, asbestos roofing is generally important to reduce the heat stress on chicken, there-by supporting with tall grass vegetation which is interspersed the chicken and enhanced good and better performance, at the concluding remarks about heat stress resulted poor performance on the domestic chicken (Halima et al. 2007).

Rectal temperature is one of the important and well considered indicator used as a physiological parameter of poultry (Halima et al. 2007), this is why usually chicken under discomfort condition can be identified by increased in their body temperature, hence this abnormal or discomfort situation can be categorized as external and internal, some external factors that could influenced the abnormalities of the chicken involve hunger, light, thirst, ventilation, caging, vaccination, and unexpected change of weather, where Internal factors consist the changes in the nervous system, sensory, nervous, endocrine, and nervous system of the chicken (Sulistyoningsih et al. 2013).

1.2.3.1. Meat quality and consumer preference on NIC

Considering the facts that there is scanty information on the above topic, but nevertheless, it obvious that meat quality of NIC have a special quality because of the genes which is serves as the major facts for breed to have effect on carcass quality and of course the organs and parts weight at maturity (gunn 2008). Research showed that naked feather have an excellent organs and parts than the normal feather chickens, and also in terms of feed efficiency and growth rate, the naked feathered is still ranking number one (Singh 1996). Meat colour is the most considering factors in choosing the kind of meat to be use by the consumers, research shows that there is correlation between colour of breast and quality of chicken meat as well as the composition and colour (Oiao et al. 2002). Other reasons that influence consumers in choosing the meat of NIC than other breeds of chickens included the toughness, taste, texture, leanness, and the chicken is essential and suitable for meal (Islam 2000).

1.2.3.2. Carcass and genes characteristics of NIC

Research shows that at 10 to 11 weeks, there are some breeds that can weighted up to 2.942kg under good management, which is against the weighted gained by most of the chicken breed. However, the slow-growing breed, has their own specific benefits, despite the facts that are not good to be selected for good growing performance purposed, but plays good in egg production, as well as disease resistance (Castellini et al. 2002). The first step used in characterised the local genetic resources goes in line with the knowledge of the variation of morphological traits (Delgado et al. 2001), meaning to say morphological measurements have essentially considered in contrasting size and shape of animals (Mckracken et al. 2000; Latshaw and Bishop 2001; Ajayi et al. 2008). However, the extend of the relations and/or variation in animal's body dimensions may be differ, especially when dimensions are treated as 2 simultaneous variance rather than many variances, due to the incorporating interrelations of the particular variables (Delgado et al. 2001). The Principal component of carcass characteristics is weighted,

why because it's strongly explain on how far is the extent amount of variance of the variables (Truxillo 2003). Body weight is always considered as a trait of vital economic importance to chicken producers, consider it as a tools that is used to estimate the weight of chickens in order to study their growth pattern and performance as well, and also leads to the development of regression equations which is designed to predict the live weight of chickens from linear body measurement (Peters et al. 2007). However, majority of the studies on body weight and morphological indices have been focused on single variance analysis of variance, despite the facts that more reliable assessment of chickens morphological inter and intra relationship could be obtained using multivariate statistical tools (Yakubu et al. 2009).

Abdominal fat of indigenous chicken is another factor to be consider in determine the gene of chicken, when the chicken is at the age of five weeks would have to demonstrate some changes, because at this stages, the chicken is genetically improve in terms of growing, although the pattern of growing is very slow (Sulistyoningsih 2013).

The most important aspect uses to highlight the carcass and genetic characters of chickens is the breed from which the chicken originated, therefore breed serves as the first and famous tools to a sustainable use of genetic resource (Lanari 2003). For example, the Ross breed of chickens has a rapid growth rate, but in terms of locomotion, the breed have low density which is as a result of poor intake in the free range system of rearing and eventually affect the digestibility due to the excess fibre content (Castellini et al. 2002).

NIC have some certain major genes, among which are naked neck, and frizzle, which have been earlier notified in chicken population (Ibe 1999) and have productive adaptability advantage (Horst 1989) due to their desirable thermoregulatory functions. (Horst 1983) and (Yunis & Cahaner 1999) showed that the adaptation potential of these group of chickens for the possession of major genes such as frizzling, and naked neck, which are strongly play a role in heat tolerance have a relation with their ability for highly conserved genetic perspective, with high level of heterozygosity which may provide biological background of genetic stocks that could improve adaptability and productivity of the chicken (Ponsuksili et al. 1996) and (Wimmers et al. 2000). According to (Adedeji et al. 2004), Naked neck and Frizzled-feathered chickens can thrive well better than

Normal feathered types in body weight, and hence, body measurement traits, while Peters et al. (2002) reported that the NIC genotypes had higher maturity rate than their non-indigenous counterpart because of the possession of major genes that aids in quick adaptation to the environment (Isidahomenetal. 2002). Genotypes in the extensive system of rearing have a great capability in expressing the natural behavioural patterns, showing good exhibitions, as well as good adaptation to un-favourable environment. However, the antioxidant level in the free range system of rearing have more capability than the back-yard, in addition to these, the sensorial quality of the meat from extensive management is also nice (Castellini et al. 2002).

1.2.3.3. Blood performance of NIC

Blood is integral part of animal's life; it can play an important role in the transportation of nutrients, metabolic waste products and gases around the body (Isaac et al. 2013)

Haematology refers to the study of the numbers and morphology of the cellular elements of the blood, it consist the red cells (erythrocytes), white cells (leucocytes), and the platelets (thrombocytes) (Merck Manual 2012), and these can be used in the diagnosis and monitoring of disease (Merck Manual 2012). Haematological studies are very important in the diagnosis of chicken diseases as well as investigation of the extent of damage to blood on the chicken (Onyeyili et al. 1992). Haematological studies are of ecological and physiological interest in helping to understand the relationship of blood characteristics to the environment (Ovuru & Ekweozor 2004) and so could be useful in the selection of animals that are genetically resistant to certain diseases and environmental conditions (Mmereole et al. 2009). Haematological parameters are good indicators of the physiological status of animals (Khan et al. 1994), and the parameter that are related to the blood and blood forming organs (Waugh et al. 2001). Blood act as a pathological reflector of the status of animals to toxic and other conditions (Olafedehan et al. 2010), meaning to say animals with good blood composition are likely to show good performance (Olafedehan et al. 2010). In addition, haematological changes are routinely

used to determine various stages and status of the body of the chickens, and used to determined stresses due to environmental, nutritional and/or pathological factors, and because of these facts, during the recent decades the avian physiology is found to be of great importance to the scientists, researchers and veterinarians as well as poultry growers (Olafedehan et al. 2010). Haematological values of chickens are influenced by age, sex, breed, climate, geographical location, season, day length, time of day, nutritional status, life habit of species, present status of individual and such other physiological factors (Dukes 1955). For proper management, feeding, breeding, prevention and treatment of diseases, it is desirable to know the normal physiological values under local conditions, but abundant haematological information of the valuable birds is hardly available in the literature, because researchers on this particular line have rarely been carried out under local chicken (Dukes 1955). However, blood represents a means of assessing clinical and nutritional health status of animals, while haemato-biochemical profiles are most commonly used in nutritional studies for chickens (Adeyemi et al. 2000) and other birds like pigeon (Pavlak et al. 2005).

The full blood count examines mostly the cellular components of blood whereas biochemical testing focuses on its chemical constituents, and it has been shown that data from blood profiles could be exploited in the improvement of chicken stocks, In addition, blood parameters help diagnoses of specific poultry pathologies and serve as basic knowledge for studies in immunology and comparative avian pathology (Isaac et al. 2013). However, there are some fluctuations or variations in haemato-biochemical profiles which have been reported in chickens of the same age and sex, and reared under the same conditions but sampled at different times of the day (Addass et al. 2012). Recently it has been demonstrated that serum lipid and serum cholesterol decreased significantly in post-hatch broiler chicks, meaning to say analysis of normal haematological, and biochemistry parameters of chickens plays a vital role in diagnosing the pathological and metabolic disorders of the poultry and can be used as mechanism to assess the health condition of a flock (Alofabi et al. 2011). However, variations in the haematological parameters are often used to determine the status of the body and stresses that is connecting to environmental, nutritional and pathological factors (Alofabiet al. 2011). Haematology in poultry are influenced by age, sex, breed, climate,

season, day length, time of day, nutritional status, geographical location, life habit of species, status of individual (Islam et al. 2004). However, there is good indication for scanty information on the haematological values of the Nigerian local chicken. The little information available were derived only from those scavenging on the free range whose management in term of feeding, housing, health etc. were neither standardized nor documented (Islam et al. 2004).

Basically, Haematological and serum biochemical parameters of poultry have been known to provide valuable information on the immune status of the host (Kral & 2000), and this kind information could be incorporated into breeding program for the genetic improvement of indigenous chickens (Ladokun et al. 2008). In the semi-humid tropics, there is no verified information on immunological parameters of native birds, especially those with native tropical or tropically relevant genes, this bring the shortcoming for the objective of the data base in order to make appropriate breeding strategies. It also affects the classification of the distinct genetic groups (Ladokun et al. 2008). However, the present study was embarked upon to evaluate the haematological and serum biochemical parameters of Nigerian indigenous chickens in a sub-humid environment. However, the potentiality of the NIC with respect to blood performance has not been fully exploited since there are still growing reports about existing or potential levels of productivity of the local breeds managed under extensive and intensive systems (Mathur et al. 1989; Peters et al. 2002). Even though several reports on performance of the NIC have been reported (Ebozoje & Ikeobi1995; Ikeobi et al. 1996, Adebambo et al. 1999), but still there are no studies on characterization of NIC based on haematological parameters, since assessment of variation in haematological parameters in NIC would further help our understanding of diversity. There are many researches that showed that males chicken generally had significantly higher values in PCV, Hb, RBC, glucose, albumin, globulin, creatinine, and cholesterol than their female counterparts, and the higher values for haematological and biochemical parameters in males compared to females may also be attributed to physiological status of the birds. (Kral & Suchy 2000) found that the high mean values in male birds have relation with the characteristic of gonad and spermiogenetic development which occurs during the period of sexual

maturation and at the onset of reproductive activity in breeding cocks (Sturkie & Oladele et al. 1986).

1.2.3.4. Factors that influenced the limitations of NIC to credit

Documentation of existing genetic resources is a very crucial component of chickens breed conservation, these could be include the biography description of the population sizes, and phenotypic characteristics of the chickens breeds, as well as their existing and potential economic performance (Ruane 1999). However, any special traits may have its cultural or historical importance depending on the society, period, and locations from which the chickens are raised. Proper making of decisions on selecting viable breeds for conservation is incorporate with several criteria that a producer has to be considered, these are directly included the extent of endangerment, adaptation of the chickens to a specific environment, possession of traits of current or future economic importance or specific scientific interest, and the cultural or historical value of the breed (Ruane 1999). For instance when we look at the degree of endangerment alone, we can realized that is probably the most important factor in conservation decisions, which some of the researchers shows that it's eventually decrease in indigenous chicken population, and hence it's so despite their favour by local people, especially in the villages, why because of the potentiality of the breed to new endorsement for some special character such as adaptability to unfavourable environments and better immune competence as well (Lwelamira et al. 2008). Poor egg production, slow growth rate, smaller egg, small body size and lack of delivering conservation efforts, broodiness, are some of the reason for decline of the viable traits that could lead the breed to high priority. NIC also have some shortcoming in their real live, among which are small body size and egg size mentioned earlier, more especially the egg, which is not preferable white colour to consumers, and low lying rate as in improved ones (Lwelamira et al. 2008), high conversion of NIC manure, and recycle back to organic fertilizer for generating meat for human consumption, which of course regard as critically endangered, resulting to the high rate of genetic abortion, are some recognized factors that push them in the red list of Intentional Union for the Conservation of Nature and

Natural Resources (Lwelamira et al. 2008), other factors that consider as predisposing to NIC is the fact that the breed is heavily Required a very long time as fattening period which results in very small and lean carcasses as well as low body weight obtained even from the matured ones. Disease outbreak such as avian influenza, risks of high mortality due to Newcastle disease, especially during cold period, disasters, such as natural catastrophes, example, flooding, policies fluctuations from public and private sectors (Kperegbeyi 1998), other factors may include none reliable cockerel exchange program, illiteracy for manpower to execute the processes of bio-techniques of NIC conservation, insufficient funds for biotechnological conservation activities such as modern molecular markers (Ajaji 2010). To eliminate some of these shortcomings, breeders have to be seriously taking recourse to intense selection on regular intervals, and again introducing of high yielding and improved counterpart for crossing (Besbes et al. 2007) thus, gradually replacing the local once. According to (Weigend & Romanov 2002) concluded that nearly half of the avian breeds of the five most popularly known species (muscovy duck, turkey duck, goose and chicken) are at risk of loss two major traits which are eventually extinct, other factors that also made a contribution for the shortfall of NIC include the facts that recommended industrial companies do not publish about the actual structure and nature of their pattern of required operation and resources, and volunteers breeders do not care about to apply a uniform method for individual identification (Tixier-Boichard et al. 2009). Furthermore, there are no prepared management board, on decisions making at many sectors, such as the academic, industrial, and local levels, and hence, these was consequently expose most genetic stocks to be at risk of being lost (Tixier-Boichard et al. 2009). Therefore, there is an urgent need to conserve the random genetic variation of existing chicken populations in order for them to be able to evolve in response to future environmental changes and to maintain the fitness against the problem of inbreeding depression (Reed & Frankham 2003), hence the danger of extinction started happening before characterization of most of these indigenous chicken. However, these problems can also be solved through improved selection and breeding with desired traits such as crossbreeding with improved non-indigenous strains, regular health and disease management, improve and conventional feeds and feeding system etc. Therefore, with good biotechnological

approach, genetic resources conservation in Nigeria, Africa, and the entire world at large, can be future develop, with desirable traits such as disease-resistant breed, rapid growth rate, better feed conversion among other, (Ajayi 2010).

1.2.4. Diseases of indigenous chicken

Disease of poultry, particularly chickens is one of the serious challenges facing the production in Nigeria and world at large, the dangerous disease that contributes a lot of casualties to NIC result from many studies showed that Newcastle disease (NCD) is apparently the most common diseases observed by poultry farmers, (Halima et al. 2007), its reported that NCD is consider to be endemic disease of rural poultry production in Nigeria, for instance, research showed that the indication of NCD among the dangerous disease of poultry under extensive management system serves as lion share towards low level of poultry production in Kogi State, Nigeria, and this is because the disease has capability to wipe out the entire poultry flock during outbreaks (Sa'idu et al. 2004). However, some of the rural poultry farmers often avoid losses from the seasonal or occasional epidemic of NCD by deliberately selling or slaughtering the chickens during the cold months (November to February), So as to reduce the flock size and stocking density as well, with an intention of prevention and control the expected disease (Nwanta2008). There are also some studies which showed that Coccidiosis is the second most common and dangerous disease from NCD seen by poultry farmers in Nigeria, followed by Fowl pox, Gumboro, and Fowl typhoid (Gary & Richard 2012). (Nwanta 2008) reported Gumboro disease to be the second most dangerous disease of NIC, and this variation is strongly depend on season or method used in the production, these diseases can be transmitted through coming in contact with infected chickens and or materials but in the small rural area, the effect of the disease via contact with infected chickens is not as heavy as large-scale production (Gary & Richard 2012). There is a tremendous expansion in the commercial poultry in Nigeria, as poultry is one of the fastest and affordable means of meeting the protein requirements for adequate nutrition needed by the human population, but unfortunately, poultry diseases are major threat to the poultry industry in the world. Ectoparasitism also plays a negatively roles in NIC

production, and its strongly affects the productivity potential since they either compete for feed or cause distress to the birds, these parasites are common in rural areas, especially those that are practicing free-range poultry systems since there is inappropriate housing and lack of appreciable pest control efforts (Mungube et al. 2006), these parasites also constitute a clinical problem, as well as transmit a number of infectious diseases and can also act as intermediate hosts of a range of helminth parasites (Arends 2003). (Moyer et al. 2002) report that parasite effect can influence the entire life span of the host, especially within the environments that has high parasitic pressure (Moyer et al. 2002).

1.2.5. Nutrient requirement of chicken

Nutrients are vitals chemicals substances which are serves as back born of feed stuffs that must be needed for normal physiological and metabolic processes of the animal body (Mac Donald et al. 1995). These substances which included protein, carbohydrate, fats, minerals, vitamins and water which are significantly utilized by the birds for maintenance, growth, egg production or reproduction depending on the purpose and objective of the production (Aduku 2004). The feed requirements of birds are regularly and strongly determined by the anatomy and capabilities of the digestive tract (Weibel et al. 1982), which are determines what type of feeds chickens could possibly ingest and types of nutrients that can successfully delivered to the circulatory system, since the alteration and impairments of feed within the digestive system may affect feed utilization and subsequently the growth of the chickens (Weibel et al. 1982). The most reliable assessment of feed quality is the extent on how it affects the performance of the birds, and this can be predicted to some extent through chemical analysis of the diet (Weibel et al. 1982). The dominant production system for indigenous chicken is extensive or free range (Kingori 2014), which is characterized by scavenging for feed throughout the whole day and confinement at night, and this nutrient intake of indigenous chicken under free-range system is enough to meet maintenance requirement, and support the growth rate and egg production as well (Kingori 2014), but some of the researchers shows that free-range feed resource base alone is not adequate

for scavenging chicks (Mwalusanya 1998), and this can be confirmed when we consider the shortage in protein and energy in the diet taken in free-ranging chicken, despite the facts that NIC are excellent foragers (Barua& Yoshimura 1997), but still have deficiency in protein sources. (Chinrasri 2009) defined nutrient requirement as the amount of nutrients needed by animals to maintain their activities which of course are declined in the extensive system of feedings, but in the backyard system nutrients like protein, lipids and carbohydrates that chickens utilizes as sources of energy or as parts of its metabolic machinery are really essential requirements for growth and of course are obtained in this system due to excess use of commercially conventionally feed, and hence aids in deposition of bones, muscle and fat, for essential individual growth and pattern of development (Carlson 1973). Apart from feed, age of the bird has important factor that contributes in response to nutrient composition of a diet, this is because muscular protein deposition is eventually decreases when chickens is beyond the stage of maturity, hence the indigenous chicken are known to be slow growing birds with a low carcass weight right from the initial stage of growing, however, the most rapid growth or weight gain is made when the chick is young (Mignon-Grasteaus et al. 2001), meaning to say as the chickens grows older, the weekly or daily increments of weight become less, although nutrient requirement increases (Mignon-Grasteaus et al. 2001). Under extensive production system, the requirement of dry matter, and crude protein intake by scavenging chicken to meet growth can be estimated using the following equations (Birech 2002)

DMI (g/d) = 22.4 + 2.25 x crop content

MEI (Mj/d) =0.15 + 0.03 x crop content

Increasing the dietary energy concentration leads to a decrease in feed intake and vice versa (Veldkamp et al. 2005), and eventually affecting the growth. (Harper and Rogers 1965) reported that shortage in protein inside a feed would drastically reduce the growth in broiler chickens, and consequently depressed appetite of the chicken, meaning to say feeding animals below their energy or protein requirements can be directly reduces growth and efficiency of nutrient utilization, therefore the Protein on indigenous chicken is good at 18% CP (Magala et al. 2012). Dietary energy from 2800 to 3000 kcal/kg ME resulted into 42g decrease in weight gain, and at 2800 kcal/kg ME an increase in

dietary protein from 18% to 20% CP resulted into a 74g decrease in weight gain (Magala et al. 2012).

Table 1. Nutrients requirement of broiler chickens as percentages or as milligrams or units per kilogram diet.

	Age in weeks			
Nutrients	0-6	6-9	9-12	12-15
ME, kcal/k	3000	3000	3000	3000
Crude protein %	24.00	20.00	18.00	16.00
Arginine %	1.30	1.10	1.00	0.90
Glycine + Serine %	1.30	1.10	1.00	0.90
Histidine %	0.54	0.45	0.40	0.35
Isoleucine %	1.20	1.00	0.90	0.80
Leucine %	2.00	1.70	1.50	1.30
Lysine %	1.20	0.95	0.85	0.75
Methionine %	0.55	0.40	0.40	0.35
Methionine + cystine %	0.75	0.65	0.60	0.50
Phynylalanine %	0.87	0.75	0.65	0.60
Phynylalanine + tyrosine%	1.62	1.38	1.20	1.10
Threonine%	0.70	0.55	0.50	0.47
Tryptophan%	0.20	0.18	0.15	0.13
Valine %	1.22	1.04	0.90	0.80

All values are expressed on as fed basis (88-90% dry matter).

Source: Olumu (2011)

2. Aims of the Thesis

There is a rapid increase in concern towards making profit in production of chicken, but still farmers need to know which of the system of rearing they can adapt to generate reliable and sustainable income. This research plays a role on which system of rearing can be suitable for a farmer. This research was aimed at compare the chicken performance under backyard and free-range systems of rearing.

2.1. Research questions

Will the systems of rearing affect the performance of weight and weight gained on NIC?

Will the systems of rearing affect the performance of feed intake on NIC?

Will the systems of rearing affect the performance of blood on NIC?

Will the systems of rearing affect the performance of carcass on NIC?

2.2. Hypothesis

Ho performance of chicken under backyard system of rearing is less than in the free range of rearing in terms growth.

Ho performance of chicken under backyard system of rearing is less than in the free range of rearing in terms of carcass quality.

Ho performance of chicken under backyard system of rearing is less than the in free range of rearing in terms blood capacity.

Ho performance of chicken under backyard system of rearing is less than in the free range of rearing in terms of feed efficiency ratio.

3. Methods

3.1. Experimental design

Total number of 80 birds of four weeks of age from naira black breed were use in conducted this research. Animals were obtained from the farmers sell centre in Azare metropolis of Bauchi state, Nigeria. Animals were randomly divided in to two groups, and each group comprises of four replicates, where each replicate consist of ten individuals. The first group of experimental animals were subjected to free range system of rearing, while the second group were subjected to backyard system of rearing. Before the onset of the research, eight separates houses were constructed for both free range and backyard system of rearing, and these 8 houses was divided in to two separate areas, the first four houses were designed only for backyard system of rearing, where the other four houses were served as only night shelters for free range system of rearing. The total area for all houses were 100m x 100m, and each of the houses were constructed with bricks block made from clays and well plastered internally and externally with the sand mixed with cement, similarly, the floor of the houses were made with concrete cement so as to avoid any crack, and the top of the floor were filled with dust made from wood, each position of feeder was covered with polythene sack so as to made easier for taken the left-over of feed, hence the light bob, thermometer, hygrometer, empty cartoon, knife, feeders, drinkers, insecticide, pesticide, weighting scale, are fixed at each room. However the area surrounded the experimental houses were intact with trees, crops, as well as domestic animals (goats), since, the farm was originally mixed farm with the total area of 20 hectres. All the experimental houses were designed the same as east to west direction at a height of 4.0m, and 3 x3mfor each house total space. The foundation of the house was made with brick block, and hay roofing sheet covered with thatched mats on top of the roofing. The open side walls were provided with some form of protective cover that were rolled or pulled up to one side so as to protect the animals against sandstorm, and rain, hence the four house were fenced separately, and again the total area of all houses were fenced with wire mesh. This research lasted for 12 weeks excluding two weeks of

adaptation. During the period of the research, the animal feed intake was recorded on daily basis, where the body weight gains were recorded on weekly basis, and each group of the experimental birds were measured at once, then again measured individually, and their values were recorded. The room temperature, environmental temperature, and relative humidity were recorded also on daily basis. Both two groups of experimental animals were treated equally in terms of feeds, welfare and management. Prior to the end of the research, the blood and carcass sample from each replicate were collected and analysed.

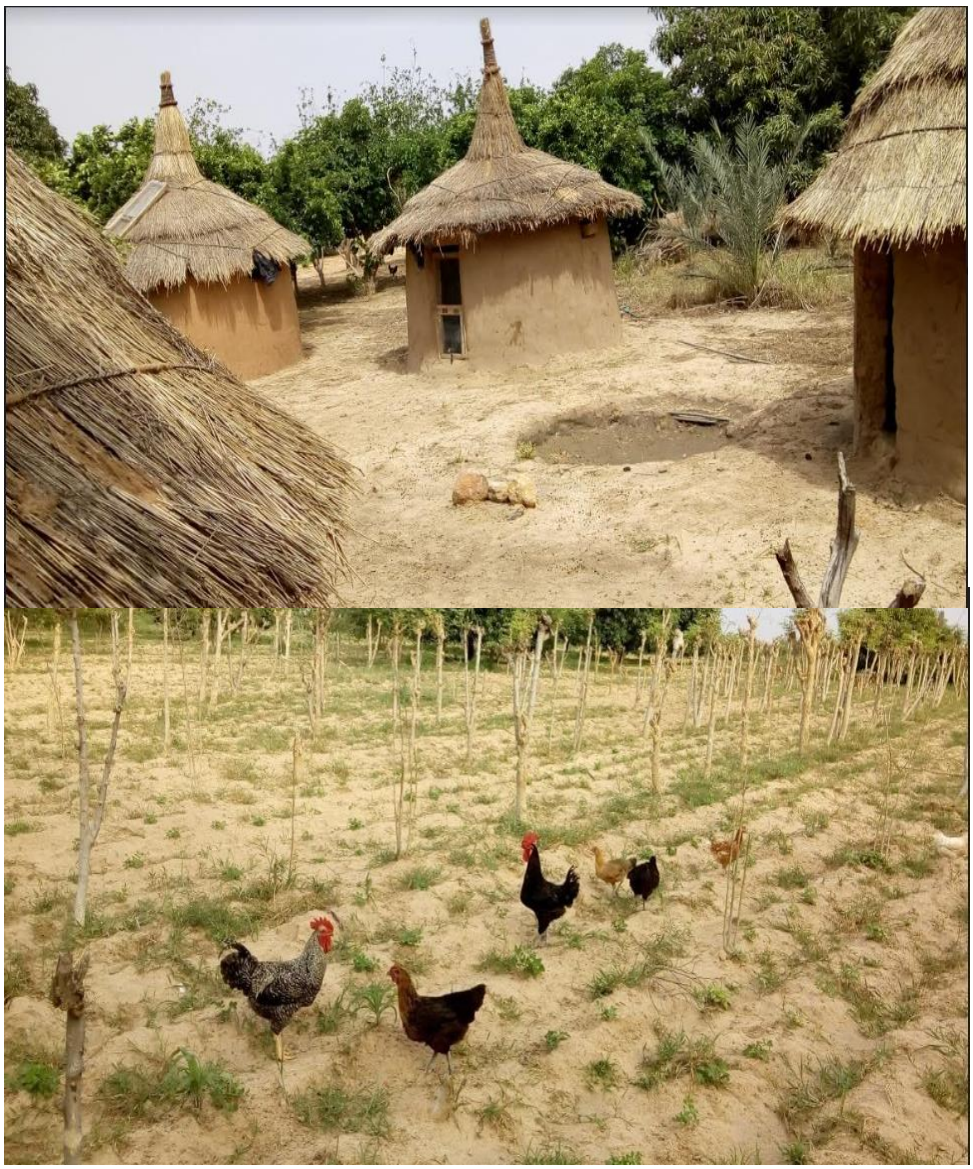


Figure 1. Housing for free-range system of rearing which used for their night shelter and experimental birds in their range during daytime.

Figure 2. Housing for backyard

3.2. Data collection

The data collection of this research was made from28 June to 28September 2019, and before the onset for the data collections, the experimental animals were subjected for adaptation period of which complete 14 days were spent. A small weighing-scale of digital type, obtained from agricultural products selling centre in Bauchi metropolis, ranging from 0 to 2000 grams with readability units of 0.001kg were used to measure 1500 grams of feed given to the animals, and this quantity was divided in to 2 equal parts, the first part, which was 750 grams were again divided in to 2 equal parts (375 grams), in which each 375 grams was given in the morning at 6:00am, whereas the second part which was also 375 grams was given in the evening at 6:00pm, and water was given *adlibitum*, each replicate of 10 birds was allocated with two feeders of miller galvanized type at the interval of 1.0 meter, as well as two drinkers of mini bell type at the same interval of the feed containers , hence each feeder is contained 375 grams in the money and evening respectively. Animals on the free range were given feed outside their house in the daytime, and inside their house when it was in the night time at 6:00pm. On each day before given the subsequent feed, the left- over of the previous feed were measured after removing the faeces and other foreign material fallen in the feed container, other remaining feed that falls on floor were strategically take off and subsequently put in to container before measuring and recording of the left over. Empty

small container was measured separately before putting the left- over of the feed, so as to determine the actual quantity of the animals feed intake on the daily basis. The digital atmospheric thermometer and hygrometer obtained from agricultural products selling centre in Bauchi metropolis, ranging from 0 to 60 degrees and 0 to 100 degrees respectively, with readability value of 0.2 degree, were hanging at a height of 0.5m above the floor level constantly in a room for collecting daily temperature and relative humidity at 6:00am, whereas the daily data for atmospheric condition (temperature and relative humidity) outside the experimental houses were collected from Nigerian metrological agency of Bauchi state chapter. At the end of every week of the research period, the weighing-scale ranging from 0 to 20 kg with the readability of 0.1 kilograms, were used to measure the experimental animal in group of 10 (1 replication) and also each and every individual were measured separately with small digital scale ranging from 0 to 2000 grams in the morning early so as to ensure accuracy, however, an empty cartoon were used for putting the birds so as to facilitates an easy way for measurement, hence the cartoon has been measured before putting the birds. Prior to the end of the research, a serum biochemistry, and haematology method of blood analysis were made before slaughtering of the animals so as to determine the health status as well as physiology of the animals. The parameters measured from the blood included the glucose, urea, creatinine, calcium, haemoglobin, pack cell volume, red blood cell, and white cell of the both free range and backyard system of rearing so as to determine which of the experimental group has better blood performance (boosting the number of red blood cells in the bloodstream with high concentration) as well as disease susceptibility (condition of the animal body which makes the tissues react in specific ways to certain stimuli and therefore the animals tends to be sick).

During the blood analysis, we selected the best and worse sample of the animal through physical observations, alone side with the determinations of body weight and performance in feed intake from each group for the analysis, and at that point there were some reasonable amount of money paid for the charge of the services assistance for the extraction as well as for the analysis of the blood respectively, the procedure used during this stage was that the blood extracted from jugular and wing vein at the veterinary clinic with the assistance of veterinary staff, in which 4ml was extracted at

first stage, then 1ml as subsequent stage, making a complete 5ml extracted from each bird, the first 4ml was used for haematology analysis, where the second extracted 1ml was used for biochemistry analysis, hence the organs for the extraction were thoroughly disinfected, and removal of the hair around the vein area used for extraction, a 5ml syringe was used for the extraction of the blood, and after extraction, the blood was immediately inserted in to ETDA containers (anti-coagulant containers) so as to avoid the blood from being clotted, and this particular sample was used for haematological analysis, then another 1mil of blood extracted from the same bird was also inserted it in to another container, which was a plain, so as to allow the blood to be clotted, and this particular sample was used for biochemical analysis, other instrument used during blood extraction for the analysis include needle, syringe, cotton, and disinfectants. The analysis of carcass was made with the assistance of agricultural department of ATBU Bauchi, and the procedure used was slaughtered all the experimental birds from all replications, and the parameters measured included liver, gizzard, lungs, kidney, heart, pancreas, spleen and small intestine, others parameters were weight of live, slaughter, dress, de-feather, feather, wing, breast, drumstick, neck, head, and shank of the animals were measured from all birds used for the experiment, the experimental birds values of their life, slaughter, and carcass weight was recorded by using small sensitive weigh ranging from 0 to 1000 grams, with readability of 0.0001 grams, and the same method was applied in all other parameters. Towards to the time for slaughtering, the birds were starved for about 18 hours so as to empty their crops, prior to slaughtered, the birds live-weight were measured, and then slaughtered and eviscerated, before eviscerated, the bird slaughter weight were recorded, and then the dressing percentages were also recorded after removing all hair of the body, subsequently the bird internal organs (liver, heart, lungs, kidney, spleen, crop, proventriculus, gizzards and intestine) were gently removed and weighted, each chicken was made in to pieces according to the following anatomical parts; head, neck, thigh, breast, back, wings, thorax, drumstick and shank. Then the weight of the individual part from each chicken was taken using sensitive balance and calculated as percentage of carcass weight. Organs measurements (visceral organs), included liver, gizzard, heart, kidney, proventriculus, spleen, abdominal fat, intestine and lungs, were also obtain from individual bird, and then weighed using sensitive balance.

Figure 3. From the left; the picture showing how blood sample is taking from the wing vein, and from the right is the picture of the blood sample in side EDTA containers, and plain (chemical free containers) respectively.

3.3. Ingredient in the commercial feed used for the experiment

The commercial grower chickens feed known as Top feed (premier) Nigeria limited used in this research was bought from Agricultural productsell centre in Azare metropolis, then name of the company of the feed used in the research was premier feed mills Nigeria limited, and the below is the combinations of the ingredient used in the feeds, although the company did not show the percentages of each ingredient at the label of the feedsack, but the names of the ingredient was showed as these: Sodium organic ground corn, organic soybeanmeal, organic wheat midds, organic canola meal, organic ground meal, organic ground flax seed, calcium carbonate, dicalcium phosphate, organic soybeanoil, choline chloride, salt, manganese sulfate, zinc sulfate, vitamin A supplement, vitamin E supplement, copper sulfate, ferrous sulfate, magnesium oxide, sodium selenite, ethylene diamine dihydriodide, organic roughage product, calcium pantothenate, riboflavin supplement, menadione bisulfate complex, pyridoxine hydrochloride, vitamin B12 supplement, biotin, folic acid, thiaminemononitrate, DL-methionine.

Percentages in the diet of premier feed mill Nigeria limited

Crude Protein, minimum19 %

ME kcal/kg 2900

Lysine, digest percent, minimum1.0 %

Methionine, minimum0.4 %

Crude Fat, minimum2.7 %

Crude Fibre, maximum 3.9 %

Calcium, minimum 1.18

Phosphorus minimum 0.45%

Threonine digest minimum 0.56

Sodium, minimum 0.15

Chlorine, maximum 0.23

Linoleic acid minimum 1

Note: the feed is produced with quality raw materials, vitamins, minerals and antioxidant.

3.4. Data processing and statistical analysis

All analyses were performed in IBM© SPSS© Statistics (version 25.0 for Windows; IBM, USA). Generalized Linear Mixed Models (GLMM) was designed to determine the effects of the rearing system on growth, blood sample and carcass parameters of the experimental birds. The birds were subject to backyard and free-range system of rearing under weeks of study. The results obtained were subjected to normality tests (Kolmogorov Smirnov). Most of the parameter measured were not normally distributed, and the threshold for significance was also considered as $P<0.05$ using Median test, Mann-Whitney and Moses test.

4. Results

4.1. Influence of rearing system on weight (kg)

Table 1 presents the result on the performance of rearing system (backyard and free range) on weight of experimental birds. The result indicates that at start of the experiment at 0, 2, 3, 4 and 5 week no significant difference ($p>0.05$) was observed between the weight of the chickens under different rearing systems. However, at week 1 and from week 6 through to week 12, the backyard system of rearing outperformed the free-range system of rearing (see Figure 4).

Table 2. Means (±SE) weights (kg) of Chicken under backyard and free-range systems of rearing during the period of June-September 2019, in Bauchi state, Nigeria.

	Week Weeks of rearing				
Rearing system	0	1	2	3	4
Backyard	0.3021±0.01	0.4003±0.02	0.5107±0.02	0.6115±0.02	0.7103±0.02
Free-range	0.3019±0.01	0.3898±0.04	0.5070±0.02	0.6058±0.02	0.7068±0.02
P-Values	0.8200	≤0.001	0.1980	0.9980	0.4620

Table 2. Cont…

	Weeks of rearing			
Rearing system	5	6	7	8
Backyard	0.8106±0.02	0.9136±0.02	1.0305±0.04	1.1284±0.05
Free-range	0.8093±0.02	0.9055±0.02	0.9411±0.02	1.0242±0.03
p-Values	0.3320	0.6790	0.0080	0.0160

Table 2. Cont...

Rearing system	Weeks of rearing			
	9	10	11	12
Backyard	1.2245±0.05	1.3297±0.04	1.4275±0.05	1.5221±0.06
Free-range	1.1287±0.04	1.2294±0.04	1.3347±0.05	1.4377±0.07
p-Values	0.3770	0.3910	0.9910	0.3710

Probability at (* = 0.05 and ** 0.01)

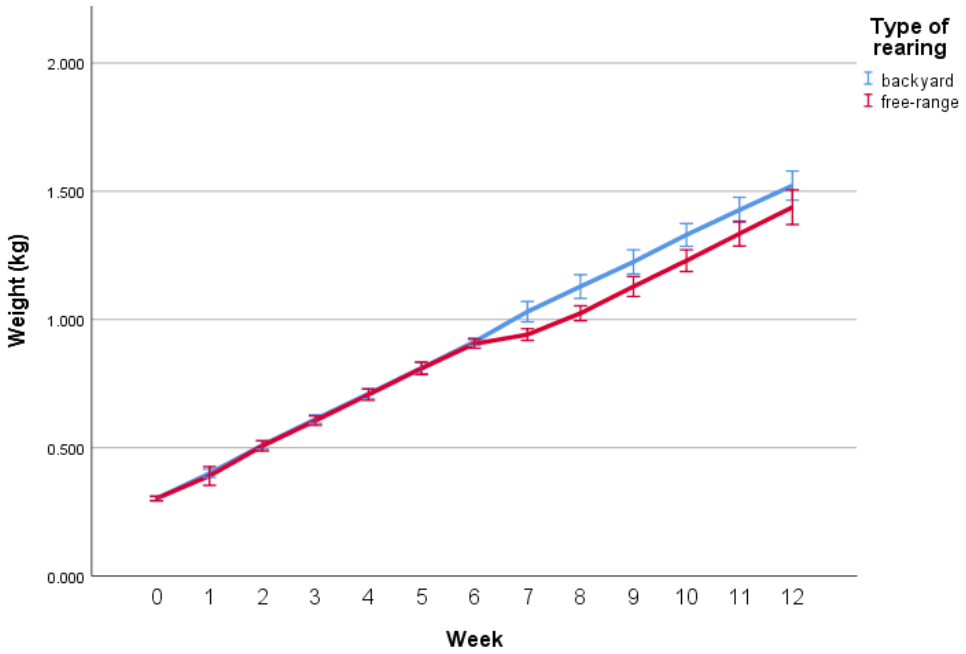


Figure 4. Presents the effects of rearing system on weight (kg) of experimental birds. The graph depicts the trend of result in Table 2.

4.2. Influence of rearing system on weight gain (kg)

The influence of rearing system on weight gain of experimental birds is presented in Table 3. At 1-week, backyard system of rearing gave a better weight gain of 0.0983 kg as compared to free-range of rearing with a value of 0.0879 kg. At 2, 4, 9 and 10 weeks of rearing no significant difference ($p>0.05$) was observed between the rearing systems. At

5 and 6 weeks of rearing significant differences ($p<0.05$) was observed. Where at 5 weeks of rearing free-range system of rearing with a value of 0.1025±0.02 kg significantly had higher value as compared to backyard system of rearing with a value of 0.1003±0.02kg. At 6 weeks of rearing however backyard (0.1024±0.01kg) system of rearing recorded higher value as compared to free-range system (0.0963±0.02kg). At 8 weeks of rearing backyard system of rearing significantly had more gain weight (0.0979±0.02kg) as compared to free-range system of rearing (0.0831±0.02kg). At 11 and 12 weeks of rearing, free-range system of rearing recorded higher gain weight as compared to backyard system of rearing.

Table 3. Means (±SE) weights gain (kg) of chicken under backyard and free-range systems of rearing during the period of June-September 2019, in Bauchi state, Nigeria.

	Weeks of rearing				
Rearing system	0	1	2	3	4
Backyard	0.0000	0.0983±016	0.1104±0.02	0.1006±0.02	0.0987±0.01
Free-range	0.0000	0.0879±0.35	0.1172±0.03	0.0988±0.02	0.0997±0.02
p-Values	NS	0.005	0.2000	0.0070	0.1110

Table 3. Cont...

	Weeks of rearing			
Rearing system	5	6	7	8
Backyard	0.1003±0.02	0.1024±0.01	0.1169±0.03	0.0979±0.02
Free-range	0.1025±0.02	0.0963±0.02	0.0357±0.02	0.0831±0.02
p-Values	≤0.02100	≤0.0020	≤0.0001	≤0.0240

Table 3. Cont...

	Weeks of rearing			
Rearing system	9	10	11	12
Backyard	0.0962±0.02	0.1052±0.02	0.0978±0.02	0.0946±0.02
Free-range	0.1045±0.03	0.1007±0.03	0.1053±0.03	0.1029±0.04
p-Values	5.2870	0.1250	≤0.0010	≤0.002

Probability at (* = 0.05 and ** 0.01)

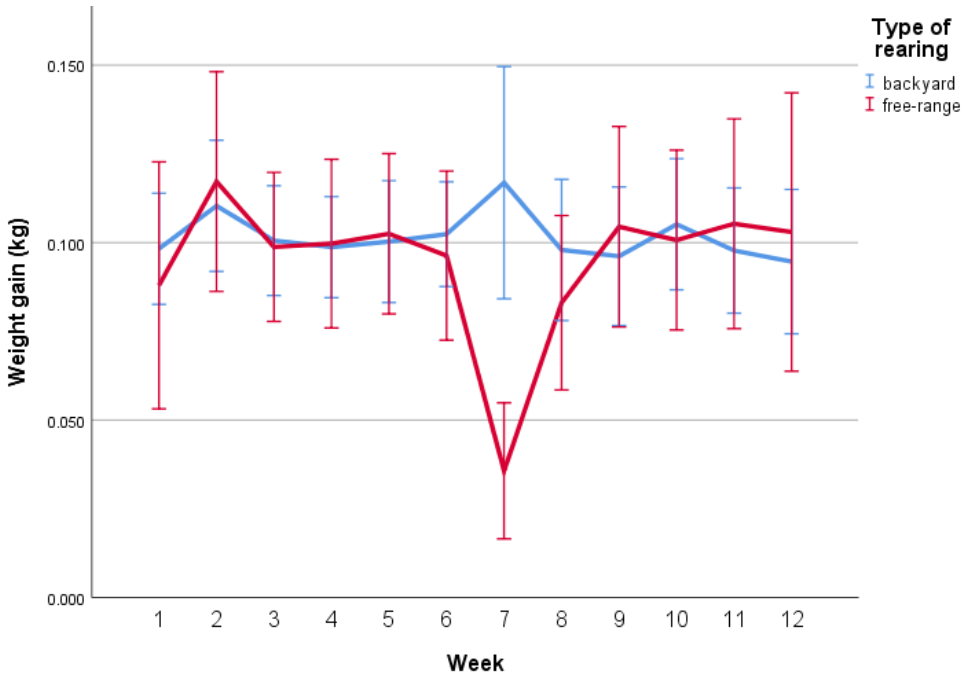


Figure 5. Presents the effects of rearing system on weight gain (kg) of experimental birds. The graph depicts the trend of result in Table 3.

4.3. Influence of rearing system on average feed intake (kg)

Table 4 presents the effect of system of rearing on average feed intake of experimental birds. The result showed that at 0 to 12 weeks of rearing highly significant difference ($p<0.01$) was observed. At 0 weeks backyard system of rearing had higher average feed intake (354.74±5.20) as compared to free-range system of rearing (354.58±3.82). At 1 and 2 weeks stage of the rearing however, free-range system of rearing recorded significantly ($p<0.01$) high value of average feed intake as compared to backyard system of rearing. Similar trends were observed at 3 weeks of rearing through to 12 weeks, were free-range system of rearing had significantly higher values of average feed intake as compared to backyard system of rearing.

Table 4. Means (±SE) average feed intake (g) of chicken under backyard and free-range systems of rearing during the period of June-September 2019, in Bauchi state, Nigeria.

	Week of rearing				
Rearing system	0	1	2	3	4
Backyard	354.7415 ±5.20	377.9487 ±7.99	399.3237 ±12.61	423.5305 ±15.39	444.0809 ±12.14
Free-range	354.5759 ±3.82	435.4300 ±23.08	519.6724 ±19.10	559.7198 ±14.39	582.7723 ±3.42
p-Values	≤0.001	≤0.001	≤0.001	0.8310	0.7640

Table 4. Cont...

	Weeks of rearing			
Rearing system	5	6	7	8
Backyard	459.7306±11.37	474.5531±12.62	488.0953±15.32	502.1308±18.51
Free-range	631.55035±9.04	685.7769±5.60	701.6459±5.79	707.636±5.63
p-Values	≤0.0010	≤0.0010	≤0.0010	≤0.0010

Table 4. Cont...

	Weeks of rearing			
Rearing system	9	10	11	12
Backyard	530.2796±19.88	564.1388±26.71	597.2720±32.35	635.0432±38.51
Free-range	714.1096±5.53	720.9324±6.90	727.4972±3.29	733.0445±10.68
p-Values	≤0.0010	≤0.0010	≤0.0010	≤0.0010

Probability at (* = 0.05 and ** 0.01)

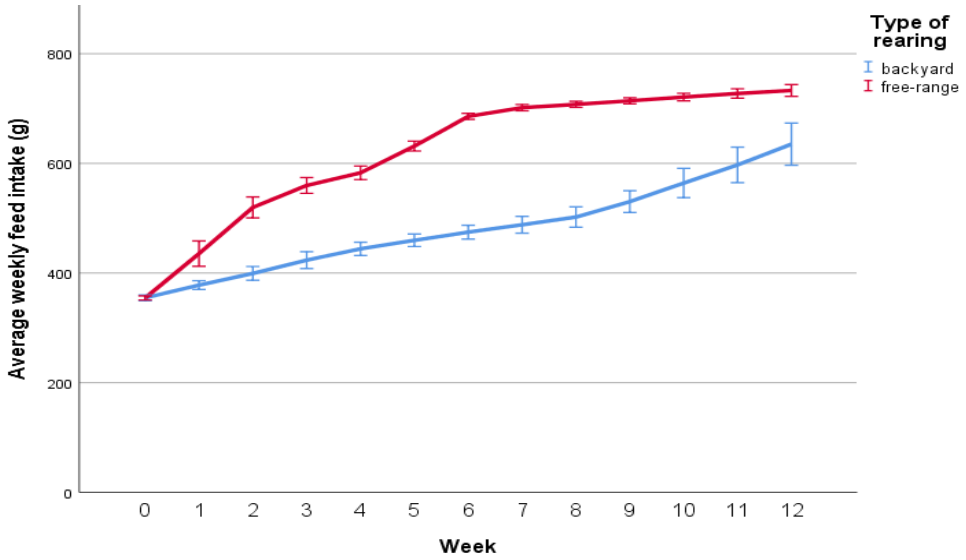


Figure 6. Presents the effects of rearing system on average feed intake (g) of experimental birds. The graph depicts the trend of result in table 4.

4.4. Influence of rearing system on feed conversion ratio

The backyard system of rearing had better feed conversion ratio as compared to the free-range system of rearing.

Table 5. Means (±SE) Feed conversion ratio of chickens under backyard and free-range systems of rearing during the period of June-September 2019, in Bauchi state, Nigeria.

	Weeks of rearing			
Rearing system	1	2	3	4
Backyard	25.9923±4.16	27.6765±4.79	23.7811±3.67	22.3985±3.42
Free-range	19.884±7.86	22.6559±6.44	17.6666±3.82	17.1089±4.03
P-Values	≤0.0010	0.0860	0.9500	0.3470

Table 5. Cont...

	Weeks of rearing			
Rearing system	5	6	7	8
Backyard	21.8483±3.69	3.1041±3.10	24.0533±1.12	19.56033.87
Free-range	16.2432±3.63	3.4684±3.47	5.0763±2.71	11.7301±0.56
p-Values	0.7840	0.5400	0.0010	0.7930

Table 5. Cont...

	Weeks of rearing			
Rearing system	9	10	11	12
Backyard	18.1997±3.86	18.7567±3.57	16.4907±3.29	15.0018±0.55
Free-range	14.6188±3.92	13.9597±3.36	14.4821±4.09	14.0275±0.87
p-Values	0.5310	0.8660	0.0490.	0.0170

Probability at (* = 0.05 and ** 0.01)

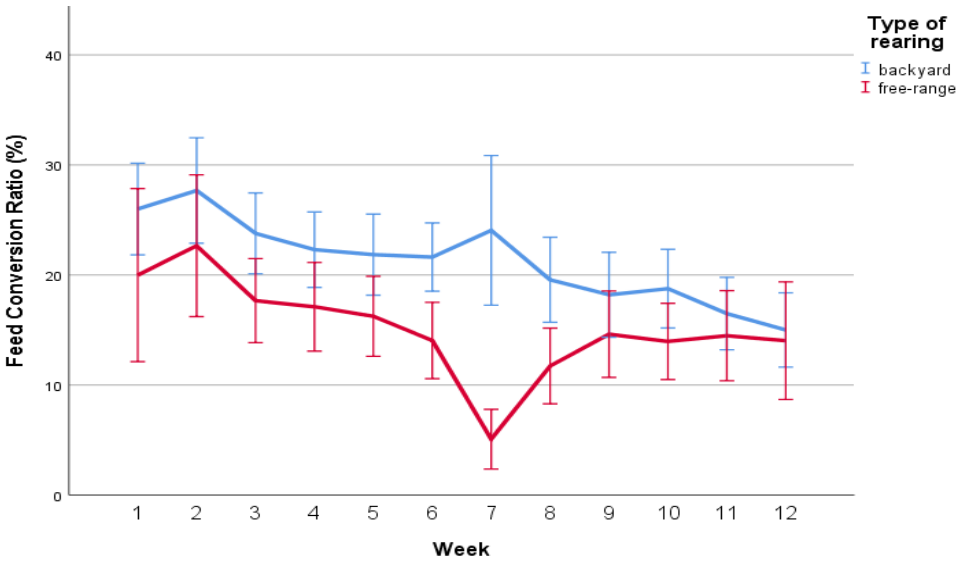


Figure 7. Presents the effects of rearing system on feed conversion ratio (%) of experimental birds. The graph depict the trend of result in table 5.

4.5. Influence of rearing system on blood sample parameters

The result indicates that all the three tests were significant only for Urea. However, all other blood sample parameters were not significant ($p<0.001$) under Mann-Whitney, and Maiden test. The Moses test was highly significant ($p<0.001$) for all the other parameters except for Creatinine as presented in Table 6 in the case of best sample choose for blood analysis.

Table 6. Presents the level of significance of rearing system (Back yard and Free- range) of experimental bird's blood sample parameters in Bauchi sate, Nigeria in 2019 for best sample case.

			P- value		
parameters	Mean ± SD (Back yard)	Mean ± SD (Free range)	Mann-Whitney U Test	Maiden test	Moses Test ofExtremeReaction
Glucose	10.6950 ±0.92	4.6300±3.59	0.0570	0.4860	<0.001
Urea	0.9150±0.13	0.6200±0.14	0.0290	0.0290	<0.001
Creatinine	47.9500±10.01	45.2525±8.04	0.6860	1.0000	0.7860
Calcium	2.3400±0.05	2.2850±0.36	1.0000	1.0000	<0.001
Hb.g/dl	9.3500±0.82	13.2750±4.13	0.3430	0.4860	<0.001
PVC perc.	28.7500±2.50	40.0000±12.68	0.3430	0.4860	<0.001
WBC. Ul	283.8500±49.05	245.9250±68.25	0.6860	1.0000	<0.001
RBC. Ul	2.6675±0.27	2.8000±1.24	1.0000	1.0000	<0.001

Probability at (* = 0.05 and ** 0.01)

Figure 8. Presents the influence of rearing system on blood glucose samples of experimental birds as presented in table 6 and 7 below. The backyard system of rearing with a mean of 10.6950±0.9198 mmol/L had significantly ($p<0.001$) higher glucose level as compared to the free-range system (4.6300±3.5893 mmol/L).

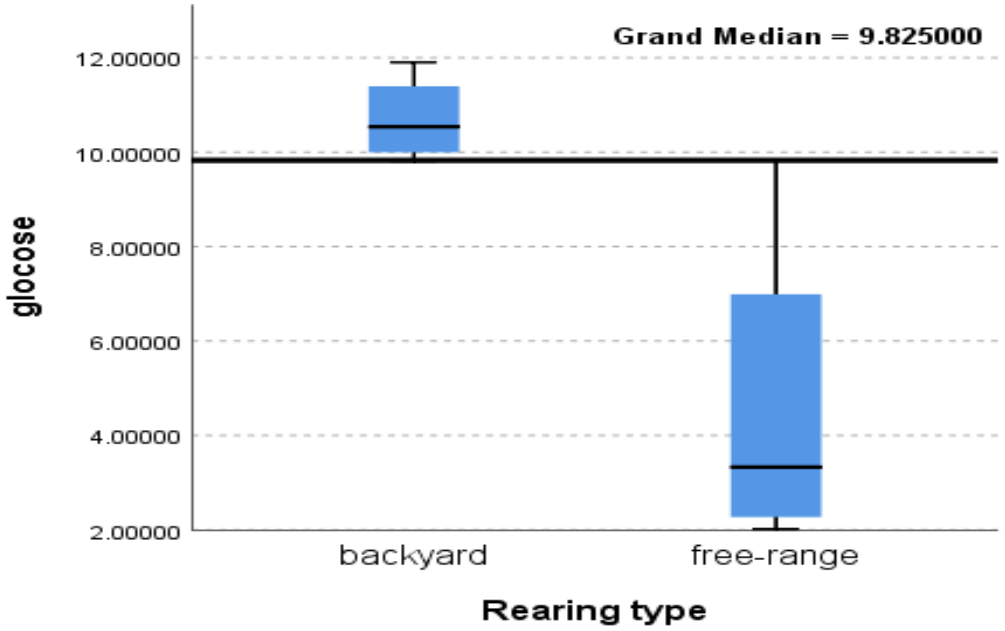


Figure 9. Presents the effect of rearing system on blood urea samples of experimental birds. Back yard system of rearing (0.9150±0.1261 dl) had highly significant urea content as relates to free range system with a mean of 0.6200±0.1374 dl.

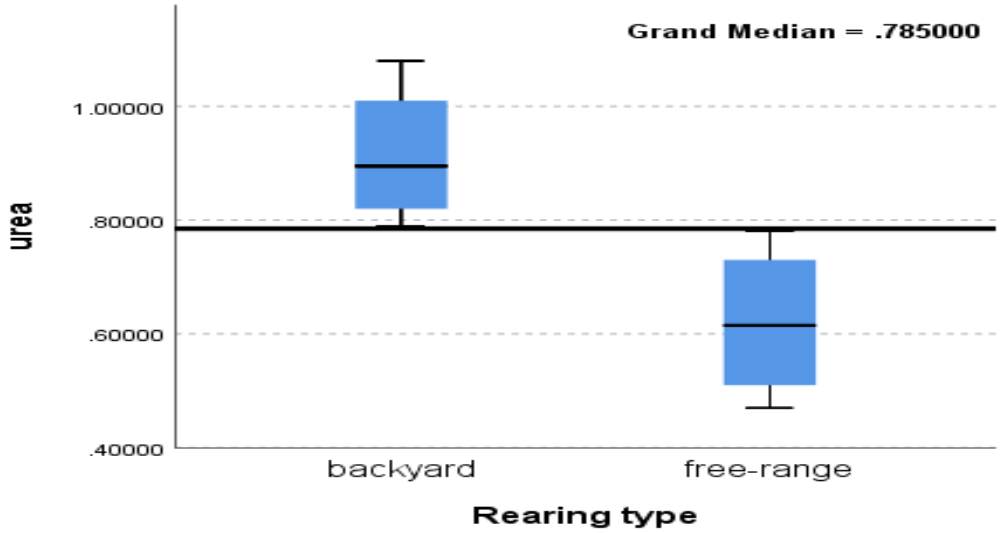


Figure 10. Present the effects of rearing system on blood creatinine samples of experimental birds. The free-range system had no significance difference as compared to the back yard system of rearing.

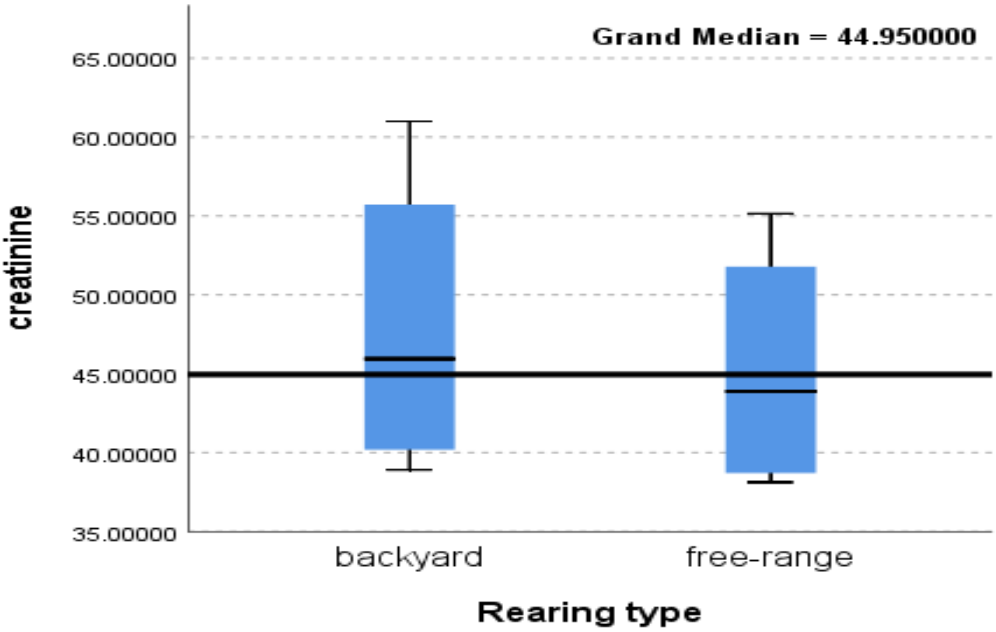


Figure 11. Presents the effects of rearing system on blood calcium samples of experimental birds in Bauchi state, Nigeria in 2019. The back yard (2.3400±0.0497 mg/dl) system is also had significantly ($p<0.001$) high in the level of calcium as compared to the free-range system (2.2850±0.3578 mg/dl) of rearing.

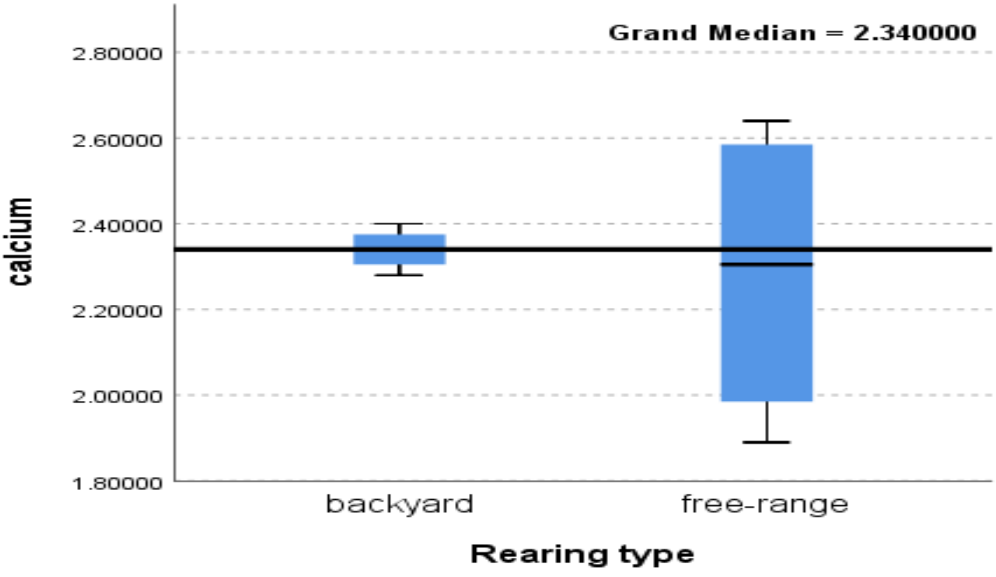


Figure 12. Presents the effects of rearing system on blood haemoglobin samples of experimental birds. Free-range system of rearing with a mean of 13.2750±4.1291 had significantly ($p<0.001$) more haemoglobin as compared to the backyard system of rearing with a mean of 9.3500±0.8185.

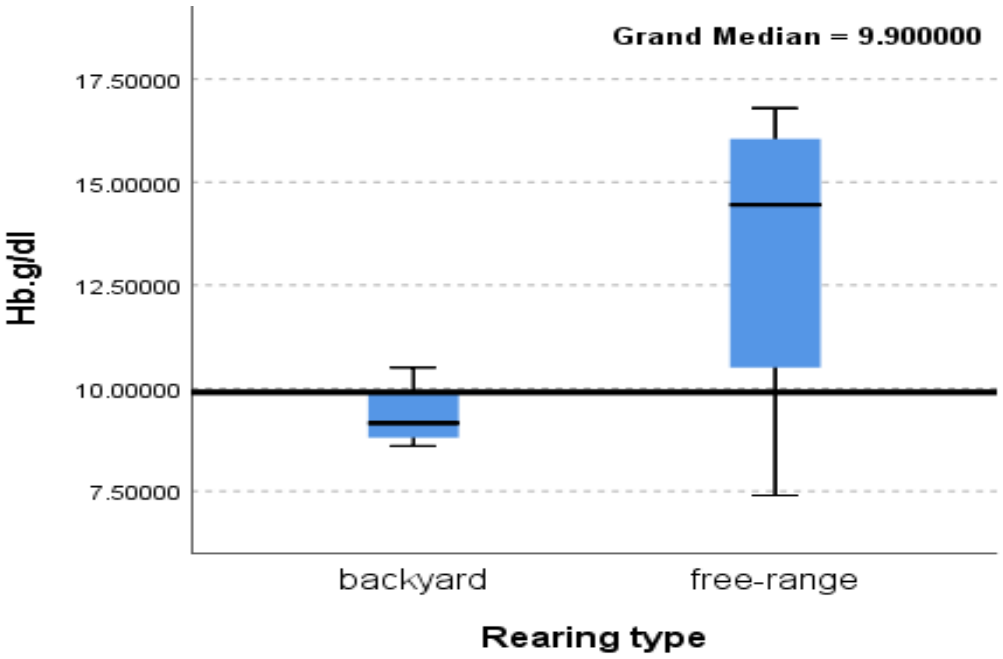


Figure 13. Presents the effects of rearing system on blood PVC samples of experimental birds. The free-range system of rearing (40.0000±12.6750 dl) had significantly more PCV as compared to the back yard system of rearing (28.7500±2.5000 dl)

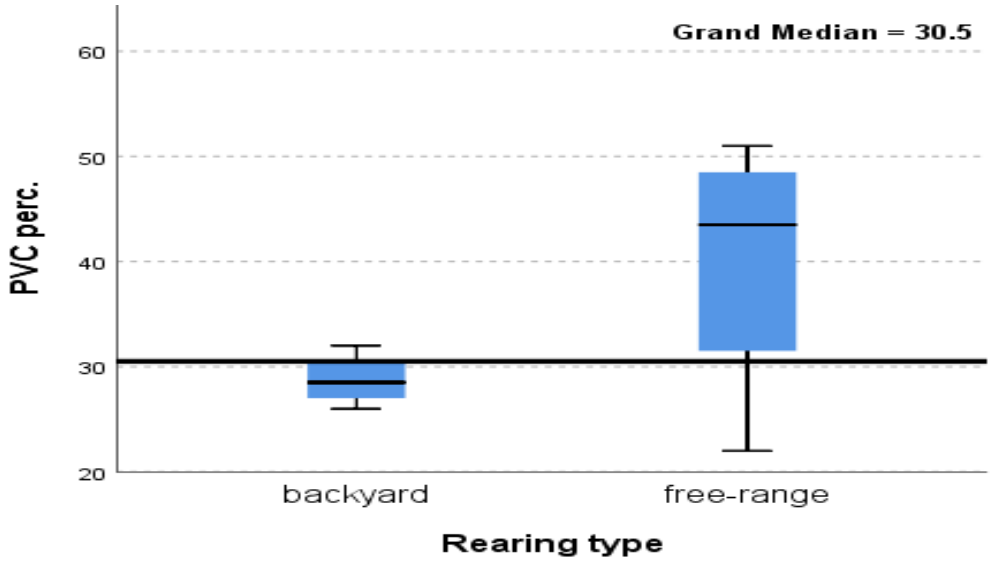


Figure 14. WBC Presents the effects of rearing system on blood PVC samples of experimental birds. The backyard system of rearing with a mean of 283.8500±49.0524 % had significantly higher level of WBC in comparison to the free-range system of rearing with a mean of (245.9250±68.2455%).

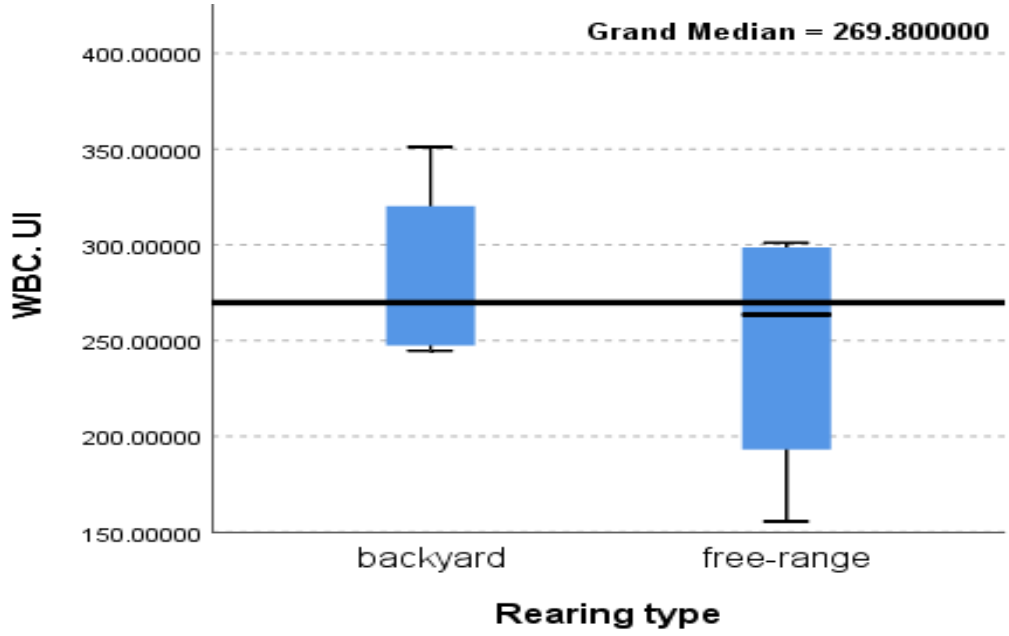


Figure 15. Show the effect of rearing system on RBC of experimental bird. The result indicated that free-range system of rearing had significantly more RBC as compared with backyard system with a mean of 2.8000±1.2401 % and 2.6675±0.2715 % respectively.

Table 7 showed the result of worst sample among the experimental birds, the effect of the worst case on rearing system shows that the Maiden test and Mann-Whitney were highly significant for Glucose, Haemoglobin and PVC. While Moses test was significant for all the parameters measured except Urea and Creatinine.

Table 7. Presents the level of significance of rearing system (Back yard and Free- range) of experimental bird's blood sample parameters in Bauchi sate, Nigeria in 2019 for worst sample case.

Blood	Mean ± SD (Back yard)	Mean ± SD (Free range)	Median Test	Mann-Whitney U Test	Moses Test
Glucose	9.1100±0.83	2.2525±0.69	0.0290	0.0290	<0.001
Urea	0.5075±0.17	0.5975±0.26	1.0000	0.4860	0.7860
Creatinine	38.4025±3.19	42.4975±18.16	1.0000	0.6860	0.7860
Calcium	2.5350±0.43	2.2400±0.59	0.4860	0.3430	<0.001
Hb.g/dl	4.5250±0.62	11.4750±1.61	0.0290	0.0290	<0.001
PVC perc.	13.0000±1.63	34.5000±5.07	0.0290	0.0290	<0.001
WBC. Ul	215.6000±32.88	181.7750±45.19	0.4860	0.2000	<0.001
RBC. Ul	2.0225±0.54	1.7500±0.36	0.4860	0.3430	<0.001

Probability at (* = 0.05 and ** 0.01)

4.6. Influence of rearing system on carcass parameters

Table 8 presents the effect of rearing system (back yard and free-range system) on carcass parameters of experimental birds. The result indicates that the test under Maiden and Man-Whitney test showed significant in all the carcass parameters except for dressing percentage and thigh and heart. While for the Moses test indicates significance for most parameters except for liver, dressing weight, breast, thigh, drum stick, shank and intestine.

Table 8. Effect of rearing system on carcass of experimental birds in Bauchi state Nigeria in 2019

Parameters (g)	Mean ± SD (Back yard)	Mean ± SD (Free range)	Median Test	Mann-Whitney U Test	Moses Test
Live weight	1516.14±66.66	1437.61±67.48	<0.0001	<0.0001	0.0620
Slaughter weight	1524.43±68.66	1443.00±66.56	<0.0001	<0.0001	0.0620
D. weight	1353.51±69.22	1257.39±62.95	<0.0001	<0.0010	0.1650
D. percentage	18.65±0.95	18.58±1.22	0.9500	0.8730	0.0110
Head	2.7057±0.33	2.09639±0.16	<0.0001	<0.0001	<0.0001
Neck	3.5442±0.33	3.10318±0.28	<0.0001	<0.0001	<0.0001
Thorax	3.5657±0.35	2.34213±0.24	<0.0001	<0.0001	<0.0001
Back	8.1566±0.47	7.75597±0.51	0.0150	0.0020	0.3710
Breast	14.9571±0.44	15.15900±0.49	0.0080	0.0120	0.6760
Thigh	8.7412±0.48	8.88221±0.52	0.4180	0.1720	0.515
Drum stick	8.6723±0.23	8.48589±0.29	0.0500	0.0060	0.5150
Shank	2.6671±0.24	2.50668±0.39	0.0010	<0.0001	0.2530
Wing	9.6085±0.23	8.46313±0.37	<0.0001	<0.0001	<0.001
Heart	0.3479±0.03	0.34808±0.03	0.5650	0.9370	0.8290
Lungs	0.03549±0.00	0.03234±0.00	0.0280	0.0200	0.2530
Liver	0.0343±0.00	0.01950±0.00	<0.0001	<0.0001	<0.0001
Kidney	0.2097±0.23	0.05229±0.00	<0.0001	<0.0001	<0.0001
Crop	0.6403±0.03	0.52482±0.03	<0.0001	<0.0001	<0.0001
Prev.	0.5929±0.05	0.0532±0.00	<0.0001	<0.0001	<0.0001
Gizzard	0.6064±0.05	0.5076±0.11	<0.0001	<0.0001	0.0110
Abd. fat	2.8601±0.35	2.1644±0.19	<0.0001	<0.0001	<0.001
Intestine	5.5655±0.28	5.3358±0.18	<0.0001	<0.0001	0.0620

Probability at (* = 0.05 and ** 0.01)

5. Discussions

5.1. Influence of rearing system on growth (weight and weight gain)

The backyard chicken performed better as compared to the free–range and this may be attributed to the fact that the backyard bird spends less energy in wandering about, which reduced their weight and also the temperature variation outside can cause this effect. The result obtained is in line with the findings of Li et al. (2017) which also reported that the growth performance of birds in the free-range raising system was less superior to that of birds reared indoor; this is likely because the free-range birds were exposed to non-stable temperatures and access to exercise in the yards, thus influenced the increasing the energy requirement and hence influencing their feed conversion. Similarly, Castellini et al. (2002) demonstrated that growth rates and feed efficiencies were lower in outdoor organic raising systems than in door enclosure systems. The findings also go in line with the observations of Castellini et al. (2008) who reported that outdoor organic treatments reduced growth rate when compared to conventional system of rearing. However, Sogunle et al. (2012) reported that the performance of birds in backyard and free range systems in terms of final weight and weight gain (in grammes per bird per day) showed no significant effect.

On the contrary, weight gain of the bird managed under free-range system of rearing had more weight gain in period of the study. However, backyard also record higher values in some weeks. This may be because of the bird's access to other sources of nutrition such as insect and worms. This agrees with the work of Li et al. (2016) who reported that birds raised in a free-range system have access to the various forages, insects, and worms found on pasture.

5.2. Influence of rearing system on feed intake and feed conversion ratio

The results obtained on feed intake indicated that the free-range system of rearing had higher average feed intake as compared to the backyard system. This may be attributed to the fact that birds on free-range expand a lot of energy in roaming about that would necessitate the need for more feed intake. The result obtained here is in contrary to the finding of Sogunle et al. (2012) who reported that, in the production systems, birds on deep litter consumed more to those reared on free range. The result obtained in this study corroborate with findings of Sogut et al. (2011) who reported that, feed intake and efficiency of organic birds were higher than conventional one.

Feed conversion ratio result indicated that backyard system of rearing performed better in feed conversion as compared to the free-range system. The high feed conversion ratio recorded by the backyard system of rearing may be connected to the fact that the birds are within a confined environment so spend less energy looking for food. The feed they consumed is equally converted because they do not move around as compared to the free-range birds. The report here, lend support from the work of Castellini et al. (2002) who demonstrated that growth rates and feed efficiencies were lower in outdoor organic raising systems than in other (conventional) systems. In another report by Dou et al. (2009) also found that free-range raising system for chickens negatively influenced feed conversion ratio. Andrews *et al.* (1997) reported that the behavior of the organic chicken (free-range) showed more locomotory activity and less resting. Therefore, their growth rate and feed efficiency were less. In addition, the uncontrolled environmental conditions in the outside housing could have increased their energy requirements with consequent rise of feed conversion.

5.3. Influence of rearing system on blood sample

The blood sample performance indicated that the backyard system of rearing performed better as compared to the free-range system of rearing for most of the blood-sampled parameters except for haemoglobin, PVC and RBC in the best case, scenario, and haemoglobin and WBC in the worst case. The relative better performance of the backyard system of rearing as compared to free-range system of rearing may be attributed to the better condition of the animals under this condition where the animal spend less time searching for food thus spend less energy and more time feeding that have a positive impact on their well-being. The result obtained here as relates to glucose is however contrary to the findings of Altıntaş et al. (1992) who concluded that glucose level were not affected by housing systems.

5.4. Influence of rearing system on carcass

The result from carcass weight depicted that backyard system of rearing performed better than that of free-range system on all the carcass parameters measured except for dressing percentage and breast. Under backyard system of rearing the birds spend less energy searching for food and it thus have a positive impact on their performance.

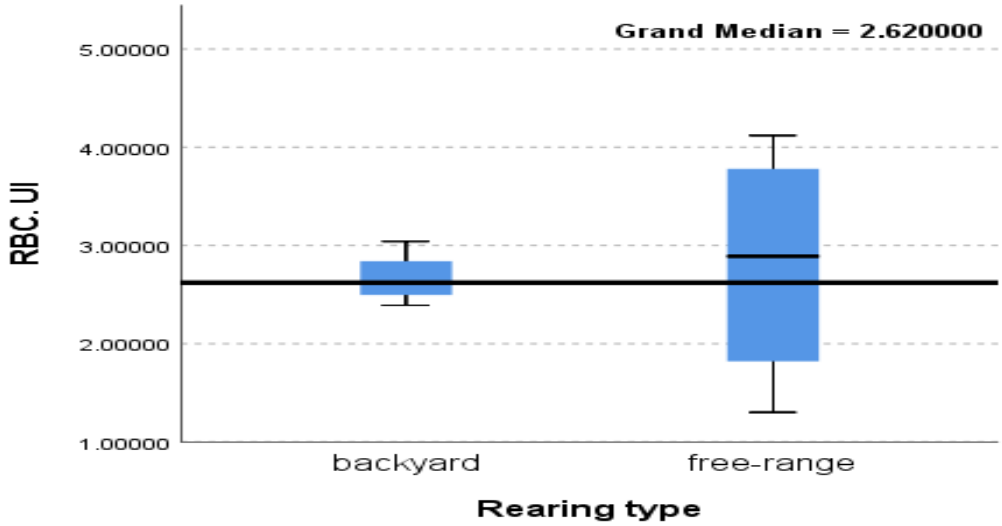
The result is in contradiction with that of Li et al. (2016) from their study; Effects of different raising systems on growth performance, carcass, and meat quality of medium-growing chickens, reported that mean eviscerated carcass percentage of the free-range chickens was not significantly different from that of (indoor-floor group and cage group) system. Similar, results were reported by Fanatico et al. (2005), Wang et al. (2009) and Chen et al. (2013). However, Castellini et al. (2002) and Feddes et al. (2002) stated that the eviscerated carcass percentage significantly increased when birds had outdoor access because of increased motor activity.

The findings here is also contrary to Li et al (2016) who reported that abdominal fat yield of chickens in the free-range system was significantly lower than that of chickens in both the indoor floor and cage groups ($P < 0.05$), their report also agrees with other

previous studies such as Castellini et al. (2002); Wang et al. (2009); Jiang et al. (2011). This may be due to the environmental conditions in the outdoor paddock, which could have increased the birds' metabolic rates and use of fat and energy, with a consequent reduction in abdominal fat deposition. Breast muscle yield was high under free-range management system as compared to backyard system of management. This may be attributed to the wandering (exercise sort off) nature of birds under free-range management system that help the bird build more muscle. This is contrary to the findings of Li et al (2016). Who reported that the highest breast muscle yield was found in the indoor-floor group, other studies by Fanatico et al. (2005); Wang et al. (2009); Jiang et al. (2011); Mikulski et al. (2011) and Chen et al. (2013)) found no significant differences in meat yield between conventionally and free-range raised birds. However, the result here lend support from the work of Castellini et al. (2002) and Feddes et al. (2002) found that the breast and leg meat percentages increased, likely because of greater physical activity, when birds had outdoor access and a lower stocking density in an organic production system.

6. Conclusions and recommendations

Rearing system had a significant ($p<0.001$) effect on the performance of the experimental bird on weight, weight gain, feed intake, feed conversion ratio, blood sample and carcass. Subjecting the birds to backyard system of rearing under the present study significantly improved the bird's performance for weight and fed conversion ratio. Weight gain and average feed intake was however, enhanced under free-range management. The backyard system of rearing also performed better in terms of blood samples and carcass parameters. Managing the birds under backyard system seems more promising on the overall performance of the bird. Therefore subjecting the birds to this system of management would have less stress on the birds, less fluctuation of environmental factors, which hampered the bird's performance under free-range system of management. Furthermore, such study can be extended to meat quality, effect of environment, profitability and potentiality of different systems of rearing; hence, the research can be extended on the performance of other breeds of birds.



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Appendices

List of the Appendices:

Appendix I. Chickens at adaptation stage

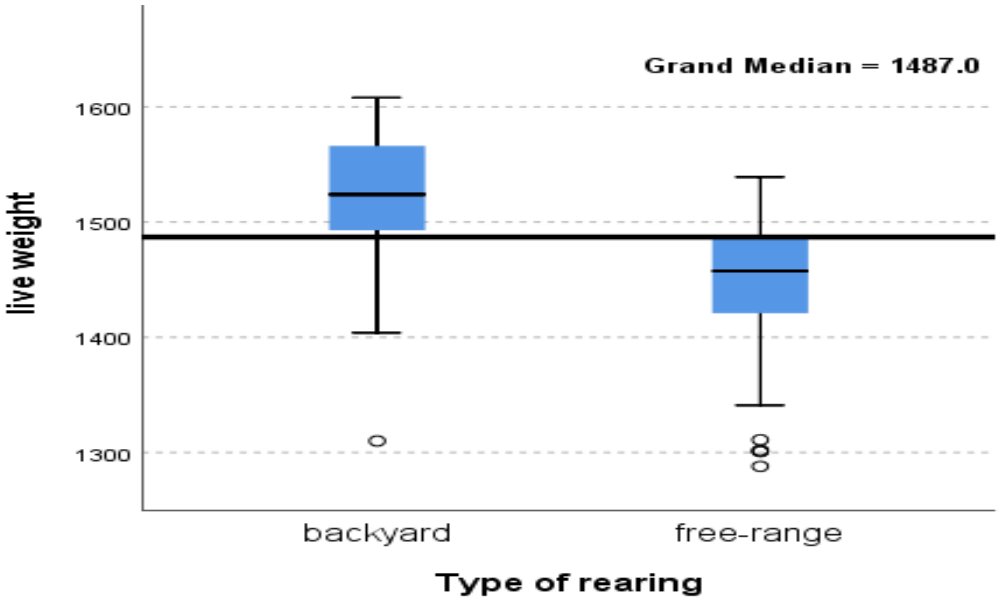
Appendix II. The container used for weighing the experimental birds with a bird inside.

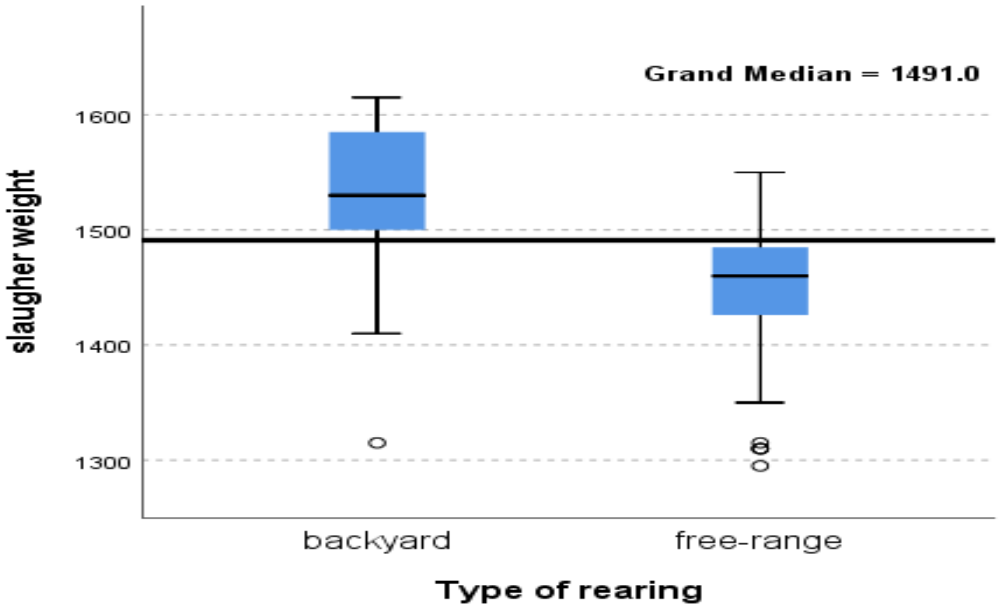
Appendix III. Chickens in replicates 1 and 2 of free-range system in the day time

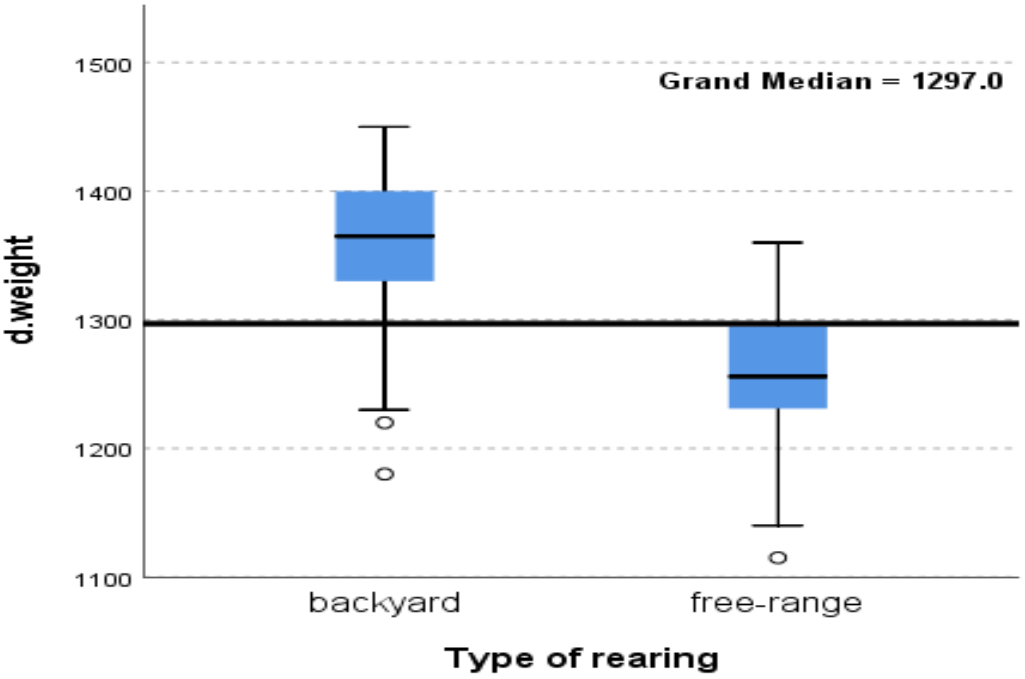
Appendix IV: Weighing of feed for the experimental birds.

Appendix V: Selected birds for blood analysis.

Appendix VI. Box and whisker graph of effects of rearing system on carcass parameters of experimental birds.



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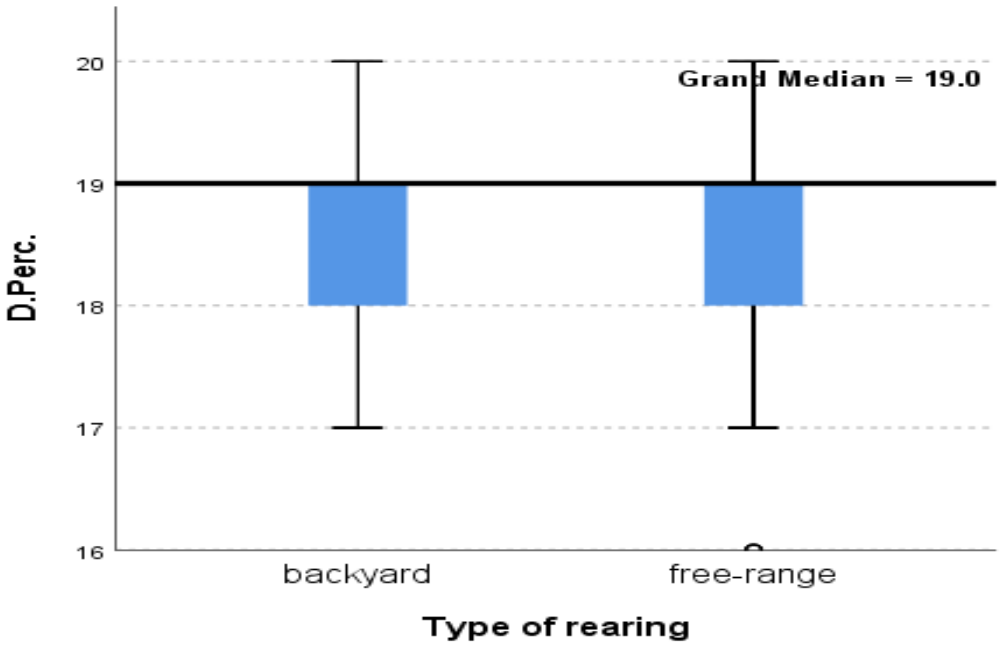
1500
1400
1300
1200
1100
d.weight
backyard
free-range
Type of rearing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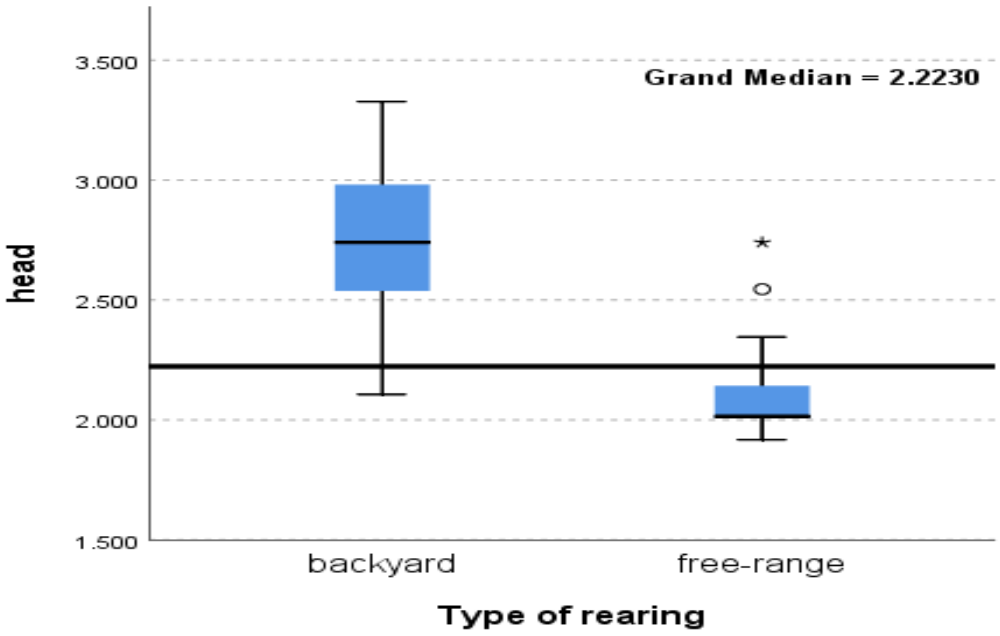
20
19
18
17
16
D.Perc.
backyard
free-range
Type of rearing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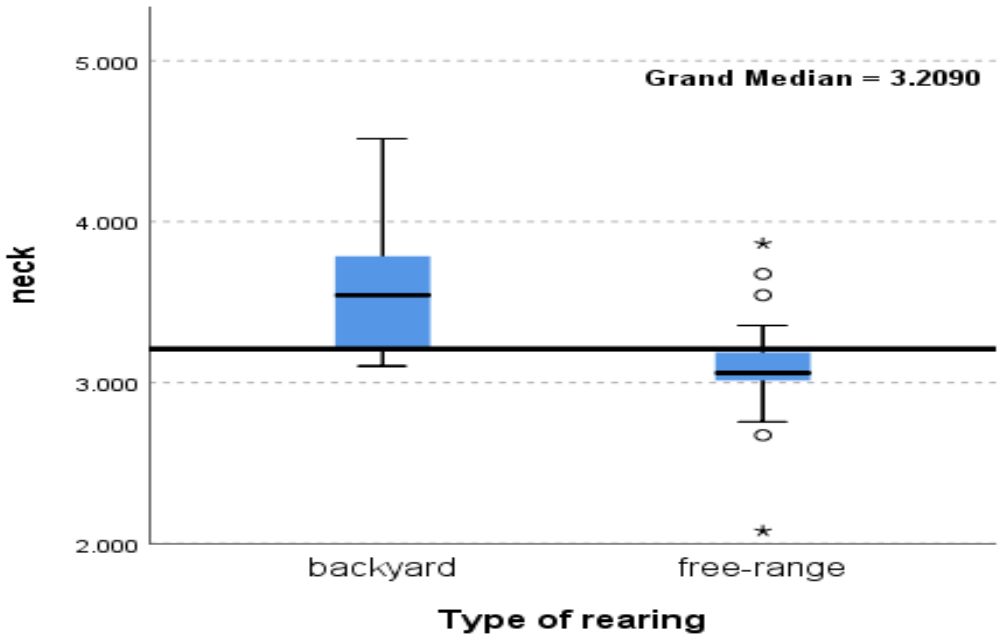
3.000
2.500
2.000
1.500
backyard
free-range
Type of rearing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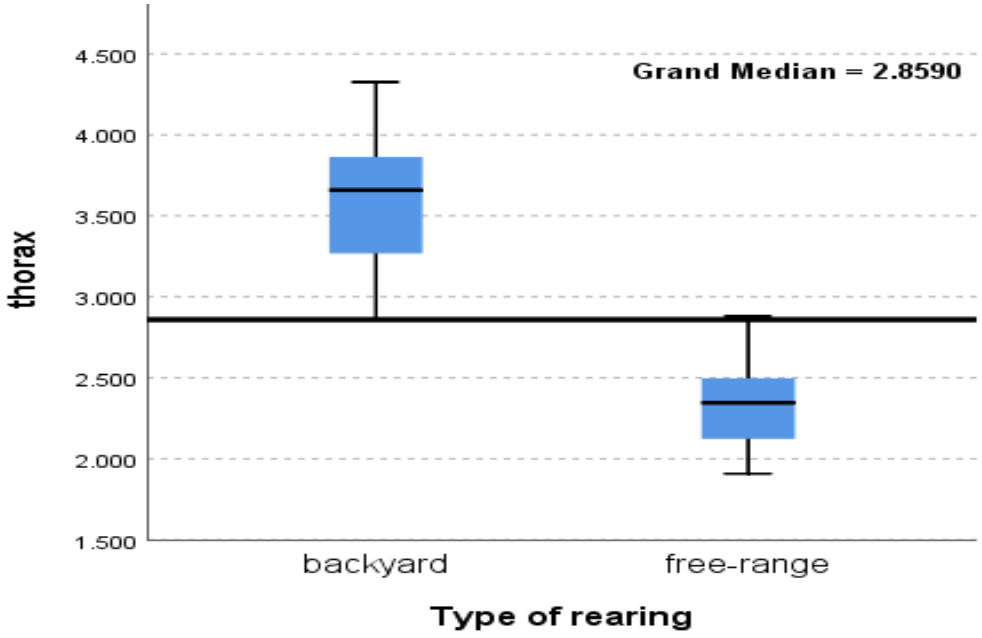
neck
5.000
4.000
3.000
2.000
backyard
free-range
Type of rearing


Grand Median = 2.8590
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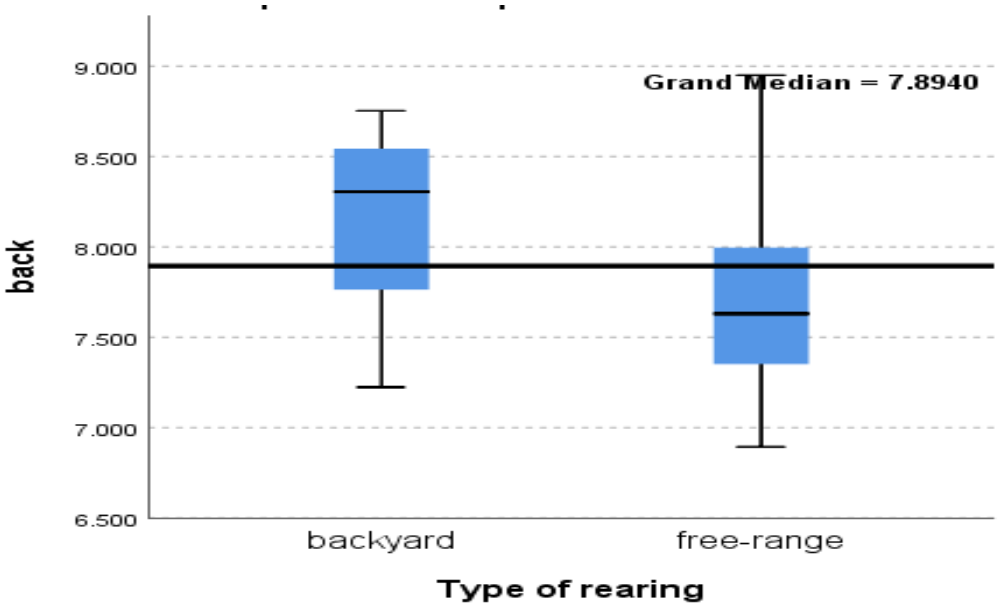
4.000
3.500
3.000
2.500
2.000
1.500
backyard
free-range
Type of rearing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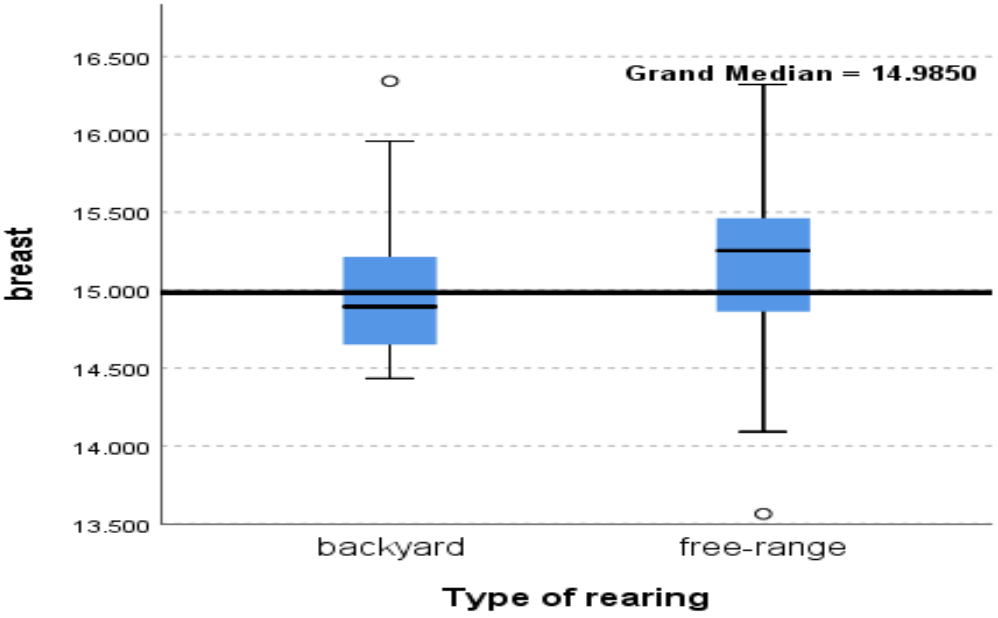
8.500
8.000
7.500
7.000
6.500
backyard
free-range
Type of rearing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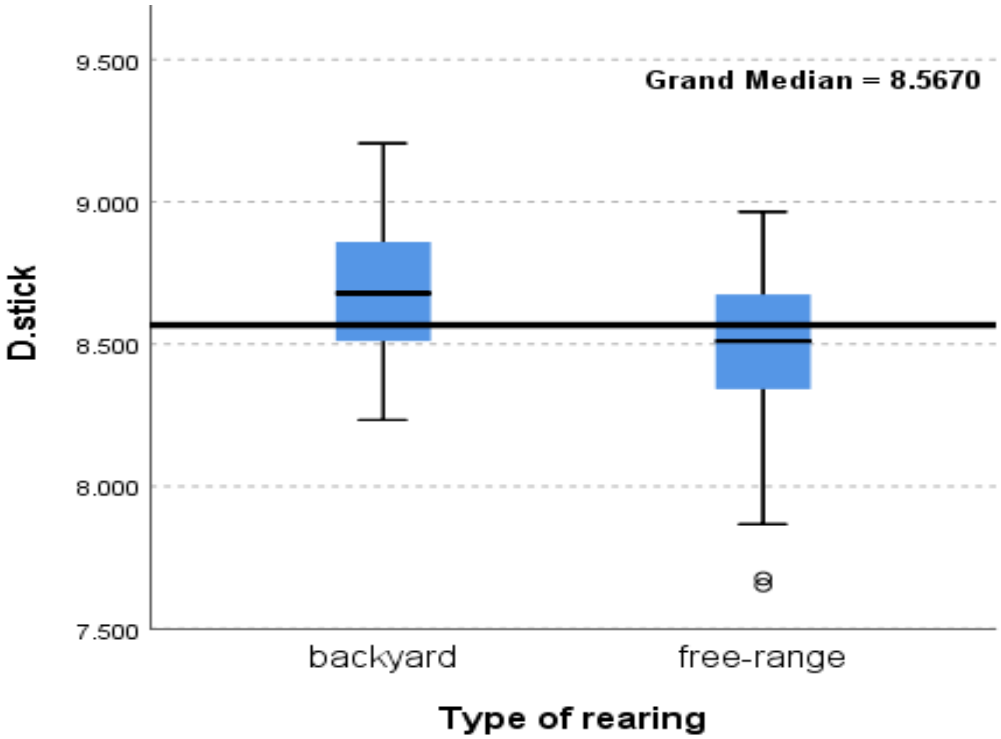
16.000
15.500
15.000
14.500
14.000
13.500
backyard
free-range
Type of rearing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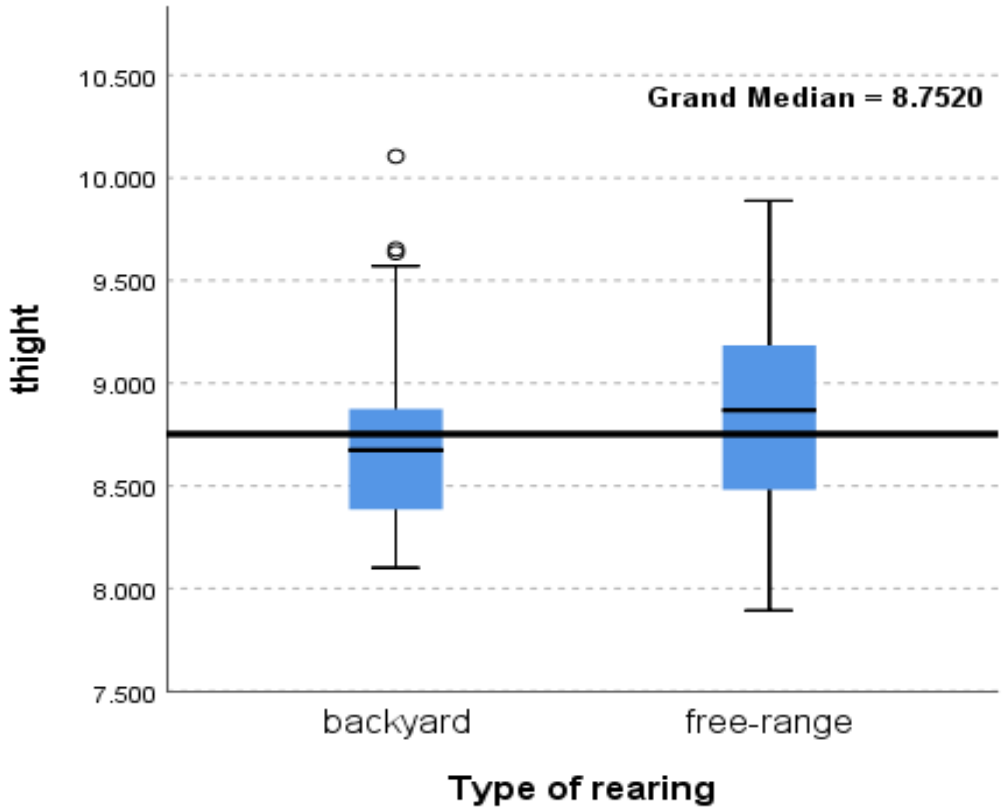
9.000
8.500
8.000
7.500
backyard
free-range
Type of rearing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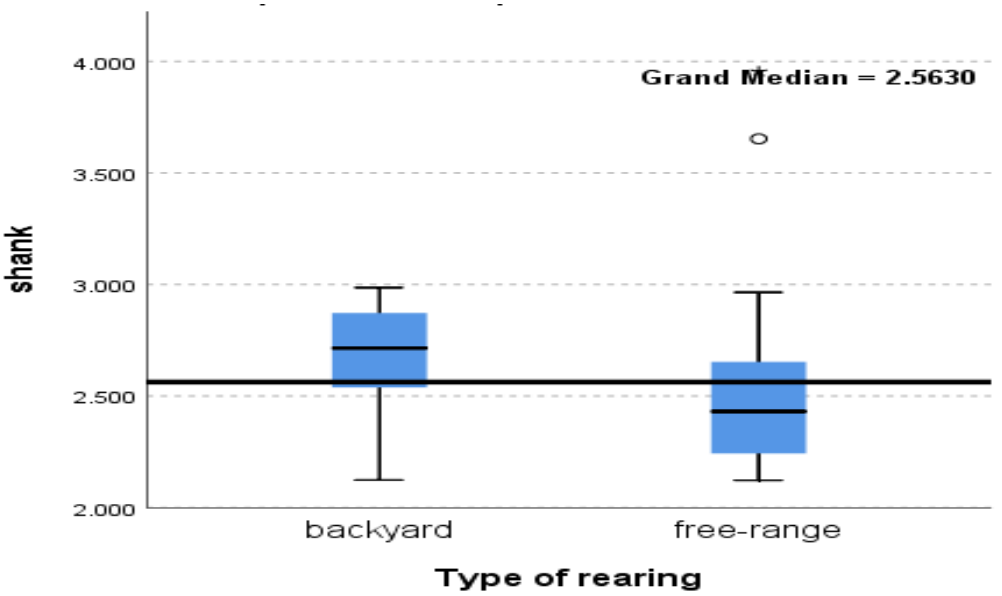
10.000
9.500
9.000
8.500
8.000
7.500
backyard
free-range
Type of rearing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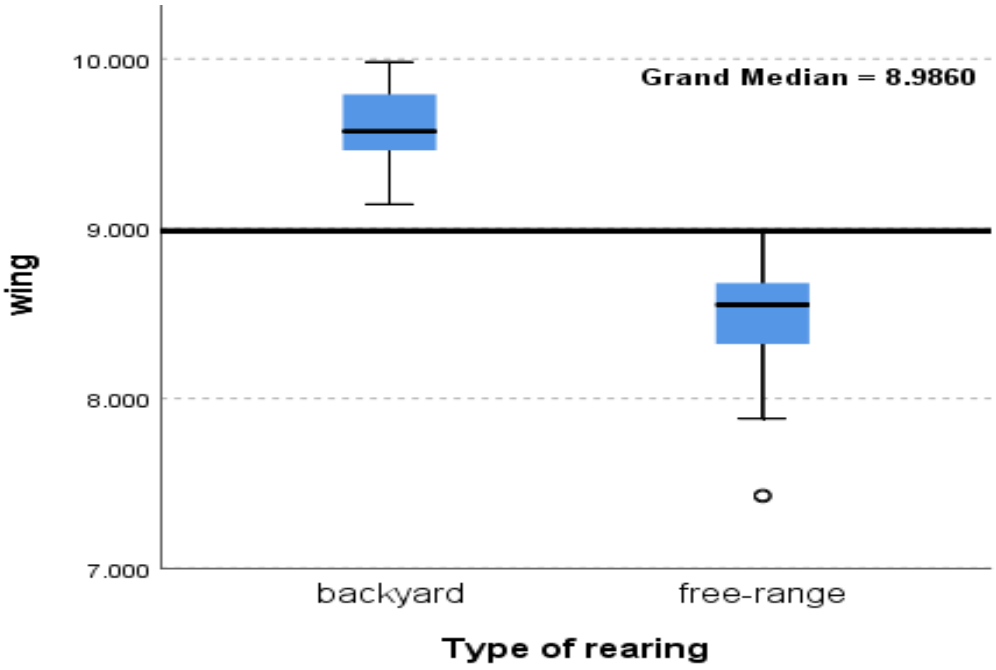
4.000
3.500
3.000
2.500
2.000
backyard
free-range
Type of rearing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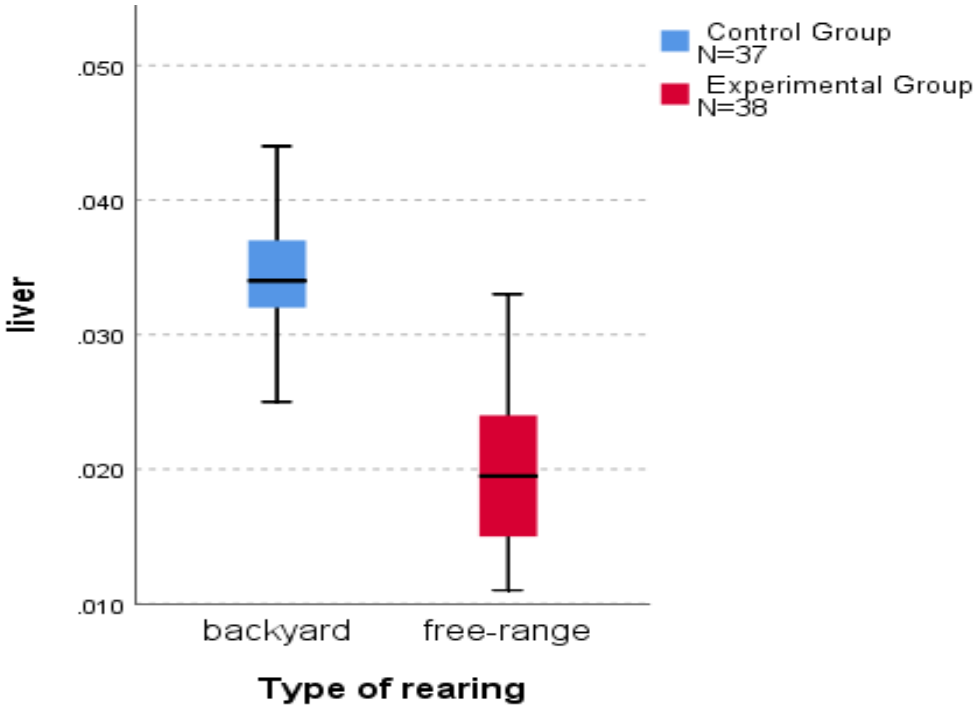
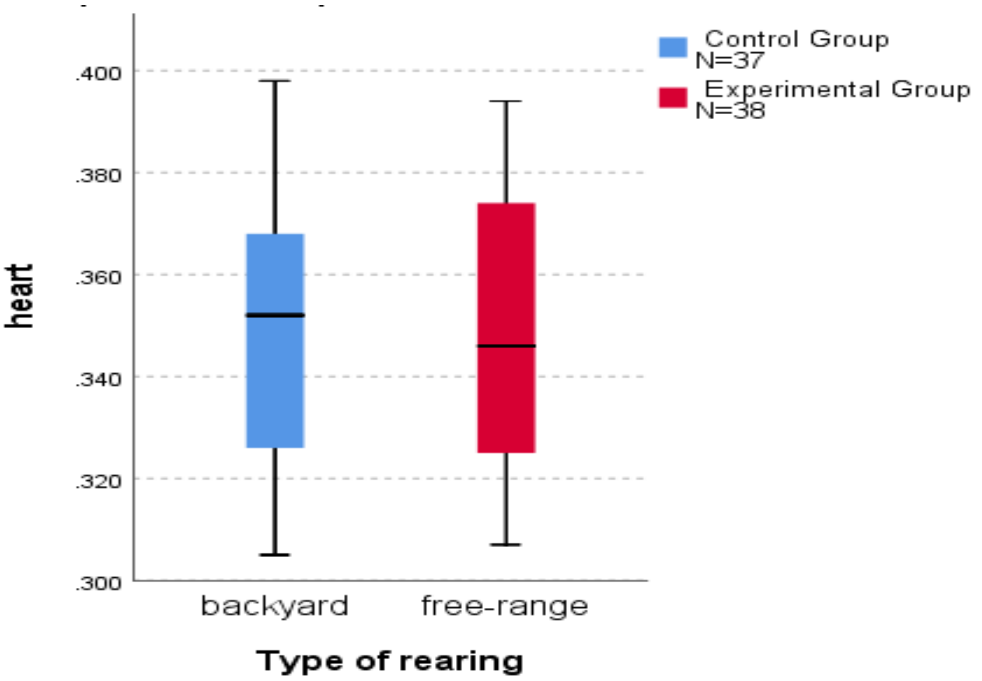
10.000
9.000
8.000
7.000
wing
backyard
free-range
Type of rearing


Control Group
N=37
Experimental Group
N=38
.050
.040
.030
.020
.010
liver
backyard
free-range
Type of rearing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Experimental Group
N=38
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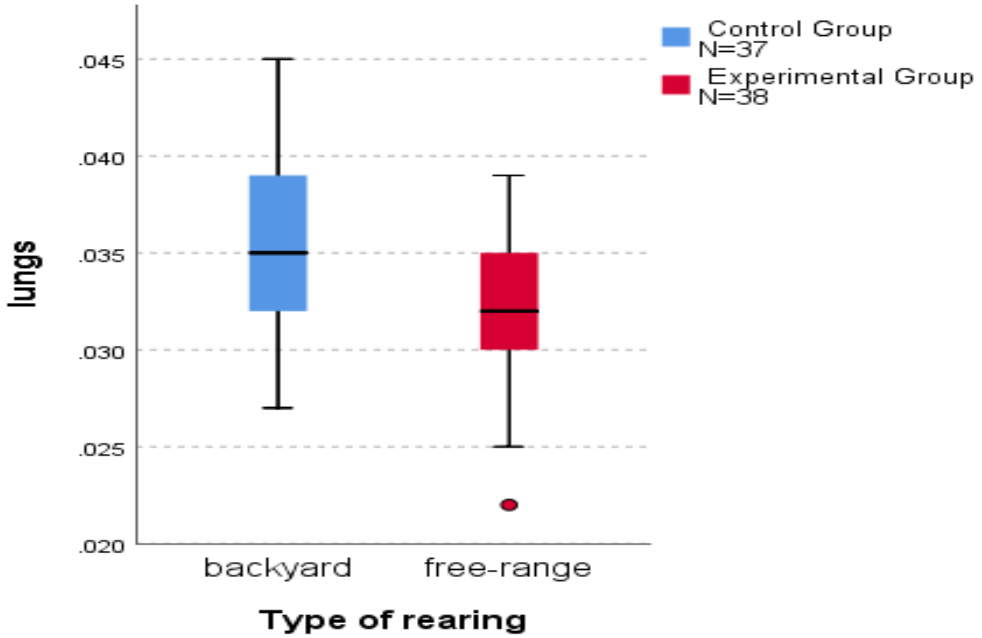
.380
.360
.340
.320
.300
backyard
free-range
Type of rearing


Control Group
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Experimental Group
N=38
lungs
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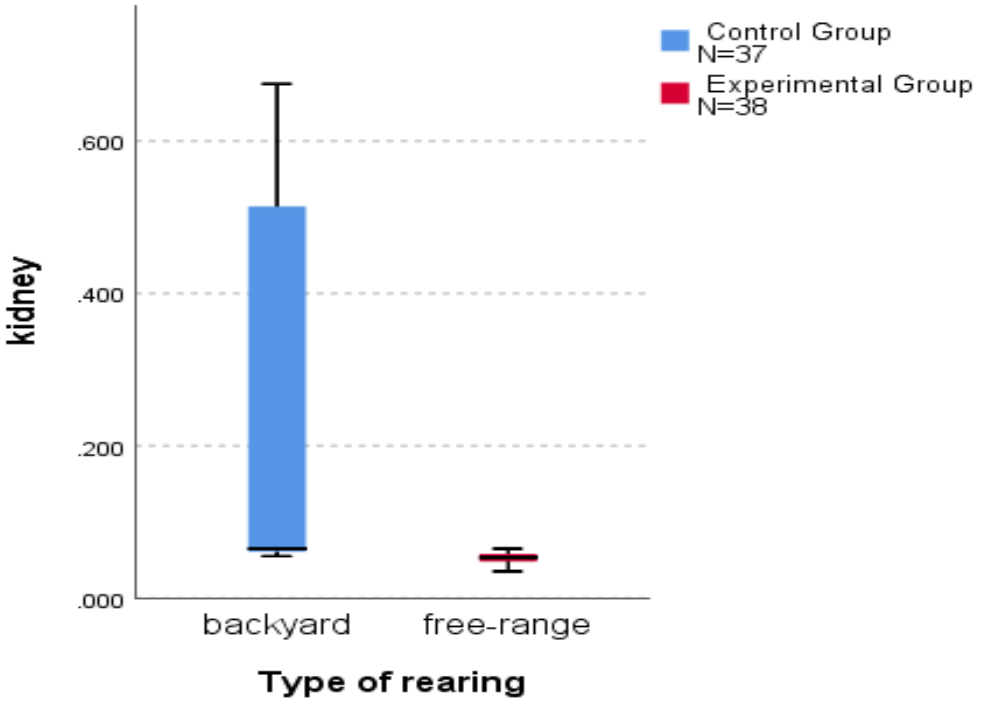
.040
.035
.030
.025
.020
backyard
free-range
Type of rearing


Control Group
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Experimental Group
N=38
kidney
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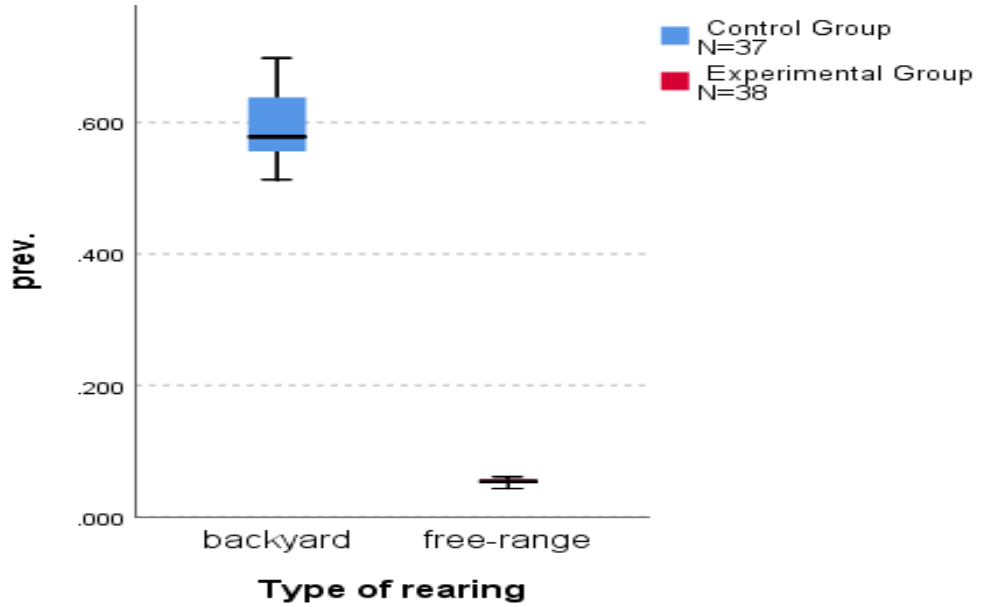
.000
backyard
free-range
Type of rearing


Control Group
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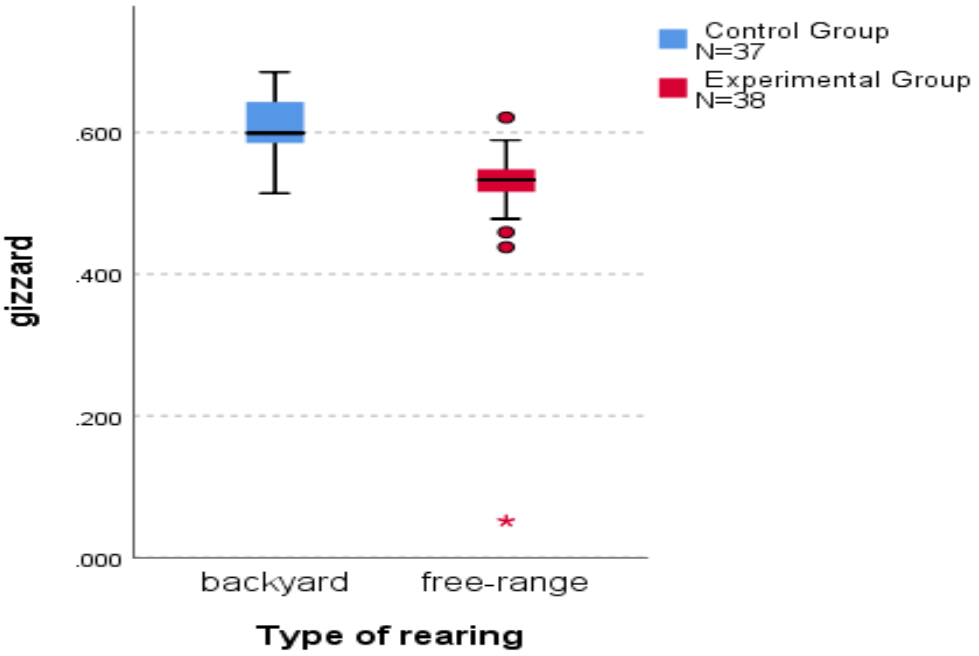
Experimental Group
N=38
prev.
.600
.400
.200
.000
backyard
free-range
Type of rearing


Control Group
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Experimental Group
N=38
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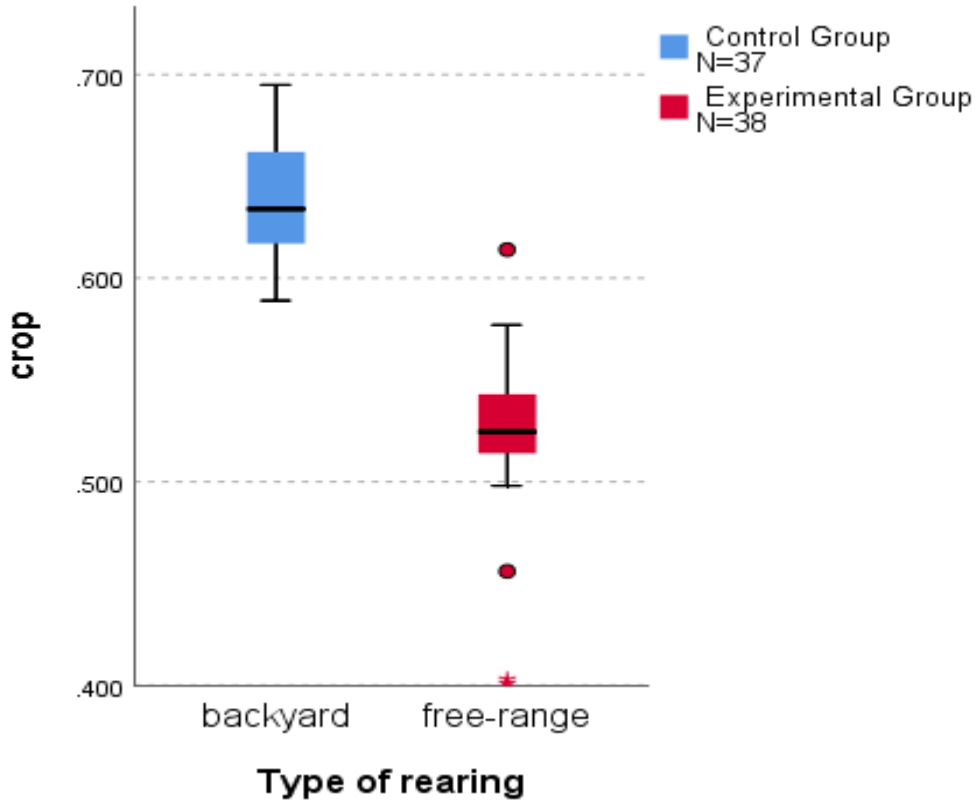
.400
.200
.000
backyard
free-range
Type of rearing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Experimental Group
N=38
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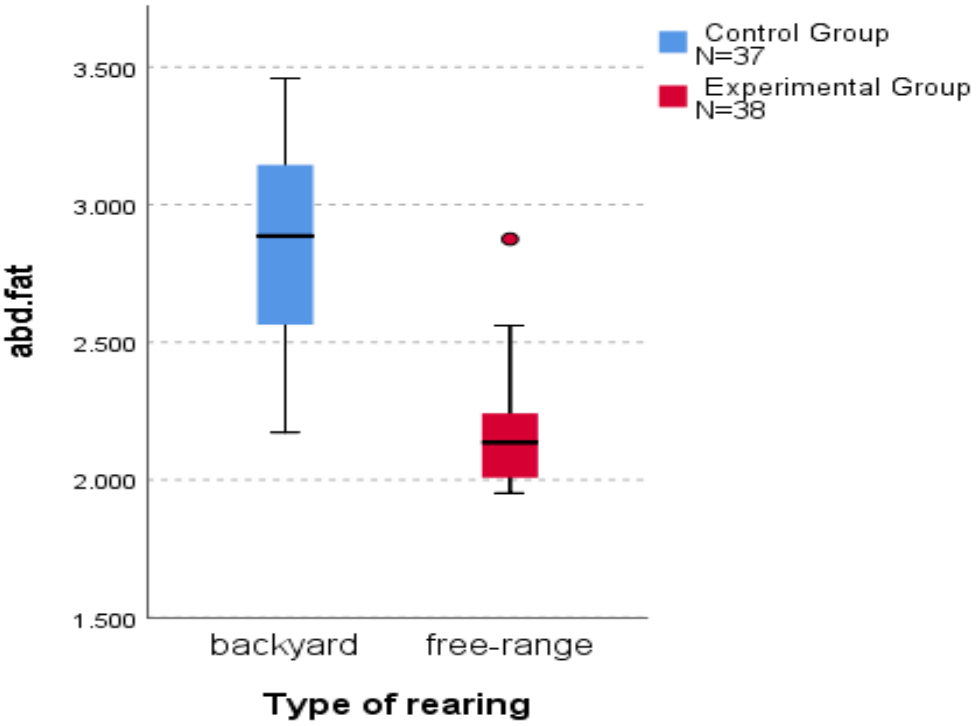
.600
.500
.400
backyard
free-range
Type of rearing


Control Group
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Experimental Group
N=38
abd.fat
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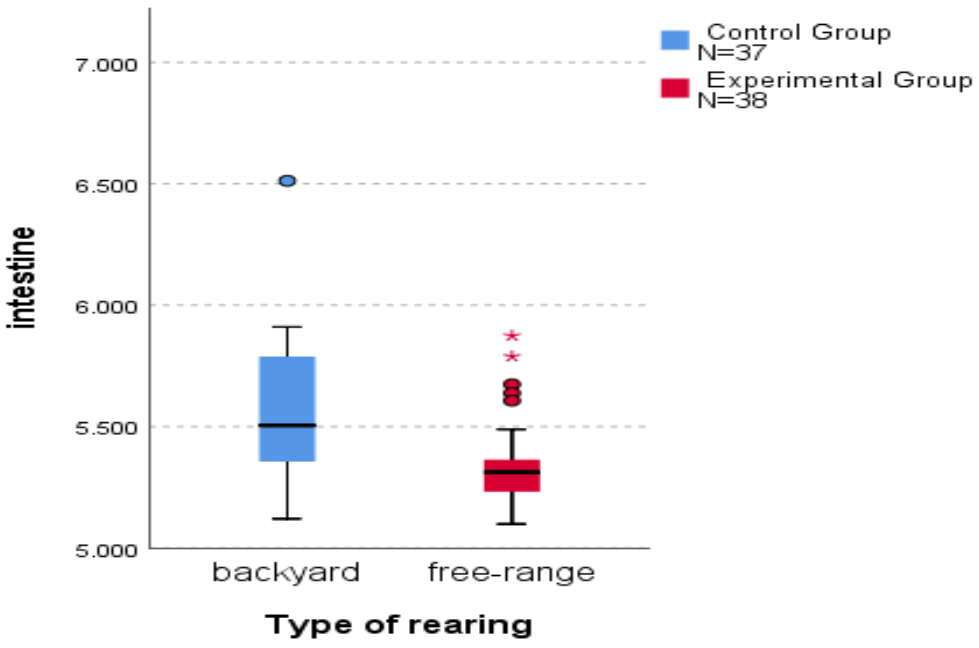
3.000
2.500
2.000
1.500
backyard
free-range
Type of rearing


Control Group
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Experimental Group
N=38
intestine
7.000
6.500
6.000
5.500
5.000
backyard
free-range
Type of rearing