FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

ANIMAL PROTEIN SECURITY AND THE ANIMAL BREEDER – WHAT RELATIONSHIP?

By

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"He has made everything beautiful in its TIME" –
Ecclesiastes 3: 11

I give all glory, adoration, dominion, praise and majesty to God Almighty, maker of heaven and earth, the Alpha and the Omega, the beginning and the end, the Omnipresent, Omnipotent and Omniscience, the One and Only.

Mr Vice Chancellor, some years ago, 1997 to be precise, I learnt from one of my secondary school classmates (we were both at School of Basic Studies, Makurdi then), that a list was drawn up by some of them. That list was broken into two; those that will credit all their West Africa Examination Council (WAEC) subjects, and those that will not. You can imagine into which group I was placed; those that will not pass, unfortunately. That was a great challenge to me and has been one of the driving forces of my sojourn on this earth. I stand before you today, ladies and gentlemen, simply a product of God's Grace and what a great privilege to be your inaugural lecturer. It simply goes to show the place of providence in the affairs of a man like me.

I am a reluctant animal breeder. Not in my wildest dreams have I ever given the thought of furthering my education/career in the area of genetics. Therefore, I feel really elated to deliver this inaugural lecture entitled ''Animal Protein Security and the Animal Breeder- What Relationship?'' Let us see a breakdown of some of the basic concepts of the title.

Animal Protein

Simply defined as that eatable protein obtainable from animal resources. The general consensus is that there is poverty in the developing world, manifesting in hunger and food shortage. This poverty-induced shortage is most felt in children and results in truncated growth and development. The World Food

Programme (WFP) (2016) in its report on the effect of food shortages especially that of protein noted that one third of all children less than 5 years old in Nigeria have stunted growth due to poor nutrition. The tunnel is even darker for women of reproductive age as the International Food Policy Research Institute (IFPRI) (2016) report observed that close to 48.5% of women of that age are malnourished and anaemic. Sikiru (2021) posited that the problems mentioned above are likely to be four times intensified in children living in remote communities. The IFPRI report actually ranked Nigeria as the 172nd nation out of 185 studied for the effect of food shortages on women of reproductive ages. These shortages, especially in animal protein, are grave in Africa not exempting Nigeria.

The Food and Agriculture Organization (FAO) as early as 2001 raised concern on this in its reports that the average daily protein intake in developing countries (4.5g per capita) is grossly below the minimal recommendation of 35g per capita. Interestingly, the same organization reported 14 years later (2015) that per capital consumption of protein in Nigeria is still inadequate; 10g per head per day as against 16g per head per day in middle income countries. Of course, this is below the global recommendation for daily protein intake per head. All these and other factors, calls for assertive action towards ameliorating the danger staring us squarely in the face. Increase in animal protein supply, achievable via increased animal agriculture, is an assured leeway to overcoming this problem. Animal protein is more beneficial compared to plant protein because of its higher biological value; this makes it more easily digested, assimilated, and used by the human body. Brown (2018) reported that animal protein tends to be more balanced containing all the amino acids needed by the body; some plant proteins may be lacking in some of the basic amino acids required by the body such as methionine, lysine, tryptophan, and isoleucine. The author also

reported animal protein to be richer in vitamins B12, vitamin D, Docosahexaenoic acid (DHA)- an essential omega-3 fatty acid, heme-iron, and zinc. Some animal products are also complete sources of protein: fish, various types of eggs, dairy products (milk, cheese, whey), red meat (from Bison, Cattle, and Deer), poultry (from Chicken, Quail, and Turkeys), and meat from less popular sources- Boars, Hares, and Horse (Johnson, 2018). While there are agitations against the eating of animal protein in certain quarters, especially red meat linking it to cardiovascular diseases, a meta-analysis carried out in 2016 according to the same author, shows that this is limited to people having at least one lifestyle risk predisposing factor, such as smoking, heavy alcohol intake, or being overweight or obese.

Food Security

Food security could mean many things to many people. Perhaps the ability by people to eat once, twice, or thrice could mean that they are food secured. However, food security as defined by the United Nations Committee on Food Security, is *'the means that all people, at all times, have physical, social and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life'* (IFPRI, 2020). The Food and Agriculture Organization recognised availability, access, utilization, and stability as benchmarks of food security (FAO, 2009a). Food insecurity on the other hand could be defined as a situation of *'limited or uncertain availability of nutritionally adequate and safe foods or uncertain ability to acquire acceptable foods in socially acceptable ways*' (Bickel *et al.,* 2000). Currently worldwide, food insecurity affects nearly 1 billion people, with 20 million being children aged <5 years who live with severe malnutrition; it is one of the "…major causes of death and disability worldwide" (WHO, 2013). This problem is not limited to developing countries alone; in the United States of America, for instance, nearly 15% of households are said to be

food insecure (Coleman-Jensen *et al.,* 2012). Food insecurity effects is mostly in children because childhood physical and mental development is hindered by undernutrition and malnutrition, thus, compromising their whole lives. Ensuring that children are exposed to adequate and balanced nutrition from an early age is therefore a condition for a society's drive for prosperity (WHO, 2013). The best and most effective way of reducing poverty, which has an effect on animal protein intake, affecting 75% of the poor in the developing world who mostly live in rural areas, and are mostly smallholder farmers, is therefore, growth in the agricultural sector (USAID, 2014). I wonder if any nation in Africa is food secured based on the earlier given definitions; not sure if Nigeria is! The pursuit of food security has been a recurring decimal in world history. Evidence shows that the ancient Chinese and Egyptians tried to achieve this by storing food which is then released to the populace during times of scarcity and famine. We see this practiced even in our local areas where food is stored for later use by farmers.

In order to achieve food security, therefore, deliberate actions will have to be taken by nations, states and individuals to consciously preventing stressors that could become pre disposers. Such factors include but are not limited to wars and conflicts (FAO, IFAD, UNICEF, WFP & WHO, 2020). Others include changing climate, global population growth, rising food prices, and environmental stressors. Mitigating strategies and policy responses are therefore required according to IFPRI (2021) and this may include, better options for handling water allocation, land use patterns, food trade, post-harvest food processing, food prices, and safety. The picture painted by recent study is, however, not too encouraging; more have joined the hungry club! This is exacerbated by the recent outbreak of COVID-19, which has added more to the world hungry by

between 82 and 132 million people (FAO, IFAD, UNICEF, WFP and WHO, 2020).

Gender inequality is also a pre disposer to food insecurity. Estimates show that even though girls and women make up 60% of the world's population that is chronically hungry, little progress has been made to ensure they have equal rights to food as enshrined in the convention for the elimination of all forms of discrimination against women. There is need, therefore, for global effort and action channelled towards the amelioration of this lingering problem.

The Animal Breeder

Gana (2018) in his inaugural lecture, quoted copiously from Genesis 1: 11-12; '*And God said, let the earth bring forth grass, the herb yielding seed, and the fruit tree yielding fruit after its kind, whose seed is in itself, upon the earth and it was so. And the earth brought forth grass, and herb yielding seed after its kind, and the tree yielding fruit whose seed was itself, after his kind; and God saw that it was good'.* If you go further down to verses 24-25 of the same Genesis 1, God also said *'Let them bring forth the living creature according to its kind: cattle and creeping things and the beast of the earth, each according to its kind', and it was so. 'and God made the beast of the earth according to its kind, cattle according to its kind, and everything that creeps on the earth according to its kind. And God saw that it was good'.* From the forgoing, it won't be wrong to say that God was a breeder! and this attribute was passed on to Adam when the responsibility of tending the garden and caring for the fish and animals came to him. Animal breeding, therefore, is since *'Imo River'* as the saying goes.

So, who is an animal breeder? It is that person concerned with the application of basic genetic principles, geared toward the improvement of economically important traits in farm animals,

for the production of products (egg, meat, milk, fur etc) useful to man, and others. Genetics as a science, deals with how heritable traits are improved in farm animals; in doing so, it encapsulates theories and borrows extensively from other disciplines. It deals with the behaviour of 'factors' called genes which are passed on from parents to their offspring during reproduction. Differences observed in animals or individuals are due to the action of genes thereby creating variation (the raw material for breeders). Using this variation, an animal breeder could improve economically important traits in farm animals; this may involve the use of simple genetic principles such as selection, crossbreeding, inbreeding, artificial insemination, to more modern methods such as genetic engineering (recombinant DNA technology), genetic modification, and gene splicing. Genetic engineering is particularly helping in shifting the frontiers of farm animal breeding through the use of technologies like DNA marker techniques, transgenesis, genomics, cryopreservation, and embryo transfer (Fayeye, 2014); others are DNA sequencing, bioinformatics, Multiple Ovulation and Embryo Transfer (MOET), DNA microarrays, cloning, functional genomics etc. The animal breeder is blessed with an array of tools which could be harnessed to bring about change required in the genetic make-up of animals. The ultimate end result is the production of farm animals of high genetic merit, leading to increased productivity and hopefully helping to close the widening animal protein deficiency gap inherent in our country today.

Relationship Between the Animal Breeder and Animal Protein Security?

The animal breeder has a great role to play in Nigeria's quest for animal protein sufficiency thereby attaining food security. It is estimated that, in the next 40 years, world population growth will continue, rising up to 9.1 billion by 2050; this has implication

for global consumption of animal products which is expected to increase even faster, especially in Asia and the Pacific (OECD & FAO, 2011). Hopefully, this increase will also be witnessed in Africa and with special emphasis on Nigeria. Recently, there have been calls for a more sustainable food production, be it crops or animals; food production should be at an acceptable cost to the planet (FAO, 2009b; Godfray *et al.,* 2010; Gilbert, 2010; OECD & FAO, 2012). According to Veerkamp (2012), food security will continue to be an important issue for the next 40 years, and the key issue facing the world is how to increase productivity in a more sustainable way with animal breeding leading the way.

Meat and milk consumption is expected to increase in Nigeria as in other developing and developed countries (Table 1). While the demand/consumption levels for livestock products in most Organization for Economic Co-operation and Development (OECD) countries with an already high calorie intakes of animal products (1000kcal per person per day or more) is not expected to change much, it is likely to nearly double in sub-Saharan Africa and South Asia, increasing from about 200kcal per person per day in 2000 to around 400kcal per person per day in 2050; levels in South America and countries of the former Soviet Union will increase to OECD levels (Van Vuuren *et al*. 2009). The expected increase in demand for meat and milk, can only be met with a corresponding increase in animal productivity. This is where the animal breeder comes into play. Going forward, it is expected that the animal breeder involves himself or herself in the development of improved farm animals which is achievable through the use of many genetic tools that are now available.

Genetic improvement of farm animals (animal breeding) is based on the application of the principle that animal products

(milk, meat, wool, etc.) and the services they provide (draught, transportation, and even social-cultural), are all functions of the genes they carry and how they react to environmental influences (genotype x environment interaction). Improvement is achieved through the selection of animals with genetic superiority; these are then used as parents of the next generation. Genetic superiority as used here means superior in terms of a particular set of characteristics, which usually include productivity in the environmental conditions expected in the future; it also considers traits such as vitality, fertility, disease and pest resistance, adaptability to a particular environment and longevity that relate to costs of production. In improving farm animals, the breeder's interest is to eliminate, or greatly minimize environmental influences including nutrition while at the same time, producing high quality and large quantity of animal products for human consumption and other purposes.

Table 1. Past and projected trends in consumption of meat and milk in developing and developed countries (projections are in italic font)

		Annual per capita consumption		Total consumption	
	Year	Meat (Kg)	Milk (Kg)	Meat (Kg)	Milk (Kg)
Developing	1980	14	34	47	114
	1990	18	38	73	152
	2002	28	44	137	222
	2015	***32***	***55***	***184***	***323***
	2030	***38***	***67***	***252***	***452***
	2050	***44***	***78***	***326***	***585***
Developed	1980	73	195	86	228
	1990	80	200	100	251
	2002	78	202	102	265
	2015	***83***	***203***	***112***	***273***
	2030	***89***	***209***	***121***	***284***
	2050	***94***	***216***	***126***	***295***

Data for 1980–2015 adapted from Steinfeld *et al*. (2006) and for 2030–2050 from FAO (2006).

Animal breeders in Nigeria have been involved in carrying out researches with the aim of improving indigenous livestock breeds. Improvement efforts were initially based on upgrading indigenous breeds using exotic breeds imported into the country or, the complete replacement of the indigenous stock with the imported ones. This, however, has failed as the exotic breeds were not able to properly adapt to the local environment and hence, could not optimally reach their genetic potentials (Adebambo, 2003). The indigenous breeds have the advantage of being able to withstand harsh climate (Yakubu *et al.,* 2010), pathogens, pests and disease pressure (Okpeku *et al.,* 2011), suitability to the traditional farming system, short generation

interval and ability to thrive on poor quality diets (Okpeku *et al.,* 2016); all these combine to make them useful for improved food production. In spite of the obvious advantages above, most of the indigenous breeds of livestock are low in productivity: egg production, low volume of milk per lactation, small body size and low in carcass quality. Improving these animals will pave the way for increased animal protein production similar to what is obtainable in European and American breeds of cattle, poultry, etc (Okpeku *et al.,* 2019).

Nigerian animal breeders have relied mostly on the use of biometric evaluation of breeding values from animal's individual performance and performance of their parents, siblings and progenies (Omitogun, 2007; Adedeji *et al.,* 2011). Research effort using these methods, has led to the development of the first commercial Nigerian breed of pig pioneered by Prof. (Mrs) A.O. Adebambo, the first female animal breeder in Nigeria and Africa. She and her colleagues have also developed two chicken lines (FUNAAB Alpha layer and broiler lines) which are awaiting national breed certification. Shika Brown- a dual purpose chicken breed was developed through collaborative efforts by animal breeders at the National Animal Production Research Institute (NAPRI), Zaria and the Ahmadu Bello University, Zaria. Scientists at the Institute of Agricultural Research and Training (IAR&T) have also developed hybrid chickens and pigs which are resistant to particular disease. Further improvement effort in other animals is, however, hampered by a lack of interest on the part of government and farmers associations. Government interest seems to be only in crop farming (as evident in the yearly budget). The number of research institutions dealing with farm animal research (only 1!), problem of funding, and conservatism on the part of livestock farmers etc. are also problems militating against the genetic improvement of farm animals in Nigeria.

There is a shift, however, to the use of molecular genetic markers technology, a powerful tool for the analysis of the genome and connecting hereditary traits with genomic variation (Yadav *et al.,* 2017). Bishop *et al.* (2002) reported molecular markers to be of particular use for genetic studies in low input livestock production systems as is obtainable in Nigeria where animals are exposed to the vagaries of harsh environmental factors, prevalence of diseases and pests, and poor management practices. Molecular markers that could be used by animal breeders in Nigeria include: single nucleotide polymorphisms, copy number variations, whole genome sequencing, and genomic selection. This kind of research is, however, at its early stage and comes with a lot of challenges bothering on equipment, absence of established livestock records and evaluation system, uncontrolled mating, government policy, poor agricultural biotechnology base, funding, poor research and development policy and priorities, poor infrastructure, insufficient trained personnel and abuse of intellectual property rights (Okpeku *et al.,* 2019). Other problems that may hamper this new method are: small herd and flock sizes, herding of cattle, sheep, and goats all year round, and even the multifaceted use of livestock- no specialized production. Overcoming these hindrances will hasten the improvement of indigenous breeds of animals, which have great implication for improved animal protein production.

My Contributions

I was a reluctant geneticist and this was reflected in the first series of experiments and papers I published. We evaluated the sensory properties of meat obtained from broilers chicken fed with different levels of Cassava Flour Meal (CFM); CFM was used to substitute maize at 0, 20 and 40% levels. Results showed that weekly Hydrocyanic Acid (HCN) intake of 75.96mg/100g and 225.31mg/100g, significantly ($p<0.05$) led to an increase in cooking losses, a corresponding decrease in the cooking yield of

meat, decreased tenderness, and palatability of the meat obtained from birds fed CFM (Table 2). Conclusively, intake of HCN had a negative effect on the sensory parameters measured and this effect was most felt in birds fed above 124.23mg/100g of HCN.

We followed this up by studying the effects of anaerobic fermentation and lyle treatment of *Delonix regia* (Flamboyant) seed meal on the performance of starter broilers. The Anaerobically Fermented and Lyle Treated *Delonix* Seed Meal (AFLTDSM) replaced Groundnut cake (GNC) at 0, 5 and 7.5% level. Untreated Raw *Delonix* Seed Meal (URDSM) was also used at 5% level. Mean body weight, daily body weight gain, mean feed intake, and mean feed conversion ratio were observed not to be significantly affected ($p>0.05$) by the substitution of GNC with AFLTDSM in the diets (Table 3). Treatment of the seed, however, improved the protein and energy efficiency ratio of the birds. It was concluded that AFLTDSM could substitute GNC in starter broilers chicken diets without any deleterious effect on the performance of the birds.

Table 2. Cooking yield, loss, pH, tenderness, juiciness and palatability of meat from broilers chicken fed CFM based diets (%)

Parameter	0% CFM	20% CFM	40% CFM	SEM
Cooking yield	65.39^{a}	62.79^{ab}	62.10^{bc}	0.71*
Cooking loss	34.61^{bc}	37.21^{ab}	37.97^{a}	0.70*
pH	5.10	5.90	5.07	0.01^{ns}
Tenderness	4.67^{a}	4.46^{a}	4.00^{b}	0.18*
Juiciness	5.00	4.65	4.50	0.01^{ns}
Palatability	4.67^{a}	4.55^{a}	4.00^{b}	0.18*

$p<0.05$, ns = not significant ($p>0.05$), SEM = standard error of mean.

Source: Egena and Ocheme (2008)

Table 3. Performance of starter broilers chicken fed *Delonix* seed meal based diets

Parameter	0% AFLTDSM	5% URDSM	5% AFLTDSM	7.5% AFLTDSM	SEM
Initial body weight (g)	60.30	60.36	61.20	60.00	
Body weight (g)	282.89	292.38	312.92	300.16	20.93^{ns}
Feed intake (g)	285.45	386.45	381.05	394.05	18.96^{ns}
Daily body weight gain (g)	13.45	14.93	13.78	13.77	5.35^{ns}
Feed conversion ratio	5.00	4.65	4.50	3.70	0.01^{ns}
Protein efficiency ratio	1.41^{d}	4.40^{b}	4.34^{c}	4.48^{a}	0.39*
Energy efficiency ratio	7.84^{d}	9.58^{c}	10.36^{b}	10.65^{a}	0.32*

$p<0.05$, ns = not significant ($p>0.05$), SEM = standard error of mean.

Source: Egena *et al.* (2008)

I got a reminder subsequently, that I was employed specifically to venture into animal breeding and genetics; an area of lack in the Department. So, a study using one of the available but not so much reckoned with micro livestock in Nigeria- the guinea pig, was undertaken. We predicted the likely live body weight of the animal using its Body Length (BL), Heart Girth (HG), and Trunk Length (TL) using a simple linear regression model. Records were taken at two weekly intervals starting at week 4. Coefficient of determination (R^2) obtained, ranged from 0.29 to 0.84; the highest (0.84) was observed at week 10. It was concluded that, early prediction of live body weight is achievable in the guinea pig from BL, HG, and TL measurements, but better at week 10 due to superior accuracy (Table 4).

Table 4. Predictive equations for weekly live body weight in guinea pig

Week	Equation	SEM	R^2
4	Y=-169+ 16.4**BL**+8.9**HG** –10.5**TL**	11.86	0.29
6	Y=-207+8.28**BL**+5.90**HG** +52.3**TL**	8.88	0.62
8	Y=-372+24.9**BL**+4.75**HG**+16.6**TL**	6.22	0.79
**10*	*Y=-401+ 18.3**BL**+20.8**HG**+7.2**TL***	*4.89*	*0.84*
12	Y=-259–2.9**BL**+38.2**HG**+24.5**TL**	8.26	0.49

Source: Egena (2010)

We carried out a survey on indigenous Nigerian chickens sampled in the three administrative zones of Niger State. Our interest was the occurrence of spur gene and its effect on selected morphometric measurements in the chickens. Our observation was that, there was a great preponderance of spur gene in the chickens sampled (0.87 vs. 0.13), and it was concluded that spur gene presence conferred some advantages on the birds exhibiting the trait as they performed better than the ones not having it state wide (Table 5).

Table 5. Effect of spur gene (sI) on metric parameters in indigenous Nigerian chickens of Niger State

Parameter	M+	M-	F+	F-	Mean	SD	LS
Body weight (Kg)	1.78^{a}	1.54^{b}	1.72^{a}	1.26^{c}	1.69	0.48	*
Body length (cm)	39.37^{a}	38.62^{a}	38.55^{a}	35.74^{b}	38.77	4.75	*
Body girth (cm)	25.57^{a}	24.80^{b}	25.58^{a}	23.84^{c}	25.30	2.03	*
Wing length (cm)	22.47^{a}	22.10^{b}	22.45^{a}	20.60^{c}	22.23	2.38	*
Shank length (cm)	11.37^{a}	10.52^{ab}	10.70^{ab}	9.90^{c}	11.01	3.96	*
Shank thickness (cm)	1.14^{a}	1.04^{b}	1.11^{a}	0.95^{c}	1.10	0.95	*
SD: standard deviation; LS: level of significance; M+: spurred males; M -: spurless males; F+: spurred females; F-: spurless females; ($p<0.05$).							

Source: Egena *et al.* (2012)

Rabbit was the model animal used during my PhD study and quite a lot of data were generated and inferences made. An evaluation of some birth traits (a day post-partum) as affected by pure strain crosses (New Zealand White, NZW x NZW; Chinchilla, CH x CH), and crossbreeding; main and reciprocal crosses (NZW x CH; CH x NZW) revealed that the birth traits were significantly ($p<0.05$) influenced by the mating type (Fig. 1 and Fig. 2, respectively). Litter size, litter body weight, and gestation length were improved as a result of the crossbreeding carried out using the two strains of rabbit. Kindling loss was also greater due to crossbreeding because of increase in the number and weight of the kittens.

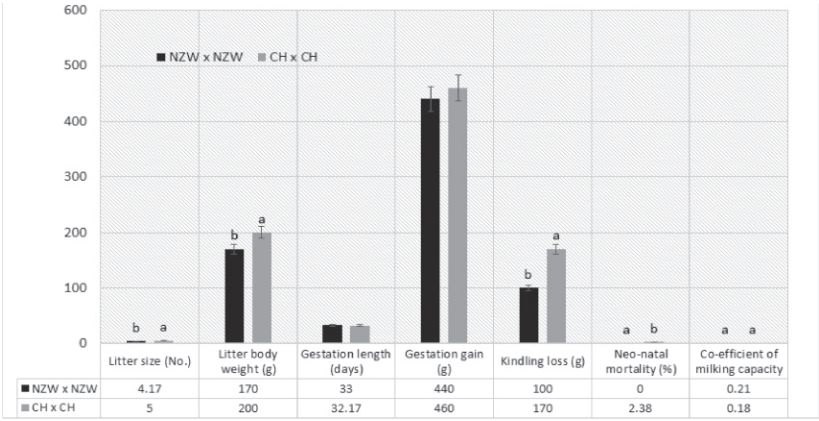

Fig. 1: Birth traits of two strains of rabbit 1-d post-partum (pure strain crossing)

Source: Egena (2012)

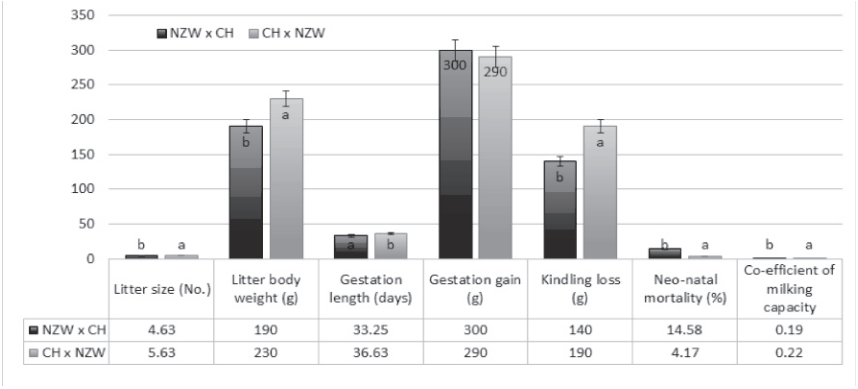

Fig. 2: Birth traits of two strains of rabbit 1-d post-partum (main and reciprocal crossing)

Source: Egena (2012)

Weaning traits (35-days post-partum) were not affected ($p>0.05$) by pure strain crossing (NZW x NZW; CH x CH) while they were affected ($p<0.05$) by crossbreeding; main and reciprocal crosses (NZW x CH; CH x NZW)- (Fig. 3 and Fig. 4).

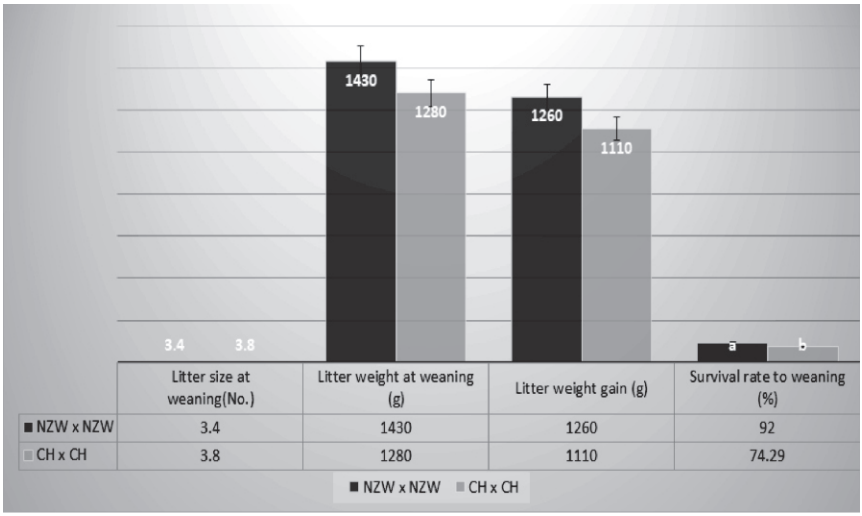

Fig. 3: Weaning traits of two strains of rabbit 35-d post-partum (pure strain crossing)

Source: Egena (2012)

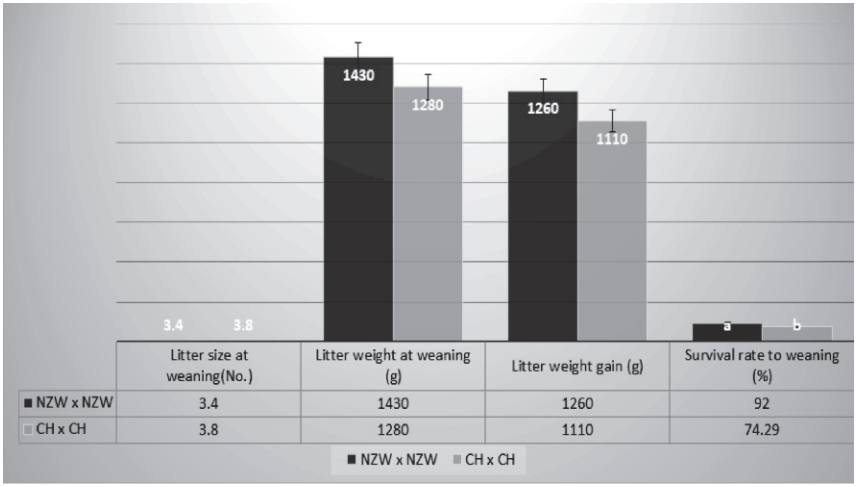

Fig. 4: Weaning traits of two strains of rabbit 35-d post-partum (main and reciprocal crossing)

Source: Egena (2012)

Estimates of heterosis accruing from crossbreeding over the pure strain crossing showed both positive and negative heterosis (Fig. 5). Of particular interest, is the negative heterosis observed for survival rate to weaning (-13.07%). The implication is that, crossbreeding involving the two strains of rabbit will result in a -13.07% reduction in mortality from birth to weaning. This has great implication on the profitability of any rabbit enterprise as more kittens will survive thereby, reaching market weight. Higher survival equates to more meat eventually.

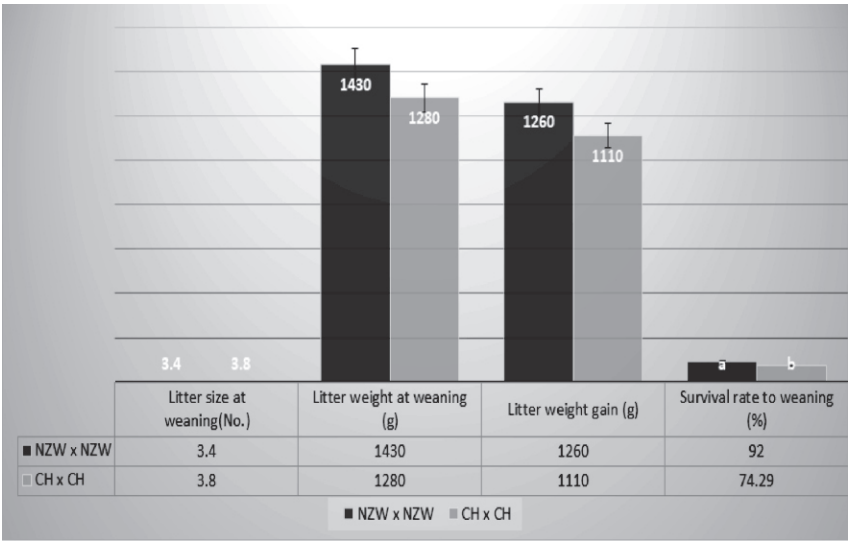

Fig. 5: Estimate of heterosis arising from crossing NZW and CH rabbit strains

Source: Egena (2012)

We went further to estimate crossbreeding effects for selected traits in the two breeds of rabbits studied and the results are reflected in Tables 6 and 7. Table 6 shows the estimate of crossbreeding effect on pre-weaning and weaning growth-related traits of NZW and CH rabbits. Results revealed significant ($p<0.05$; 0.01) breed differences for all the traits except, nose to shoulder length (21-d), and for all the traits except nose to shoulder length, and trunk length (35-d). Direct heterosis was negatively significant ($p<0.05$; 0.01) for all the traits except nose to shoulder length (21-d). Individual body weight and length of ear showed significant ($p<0.05$) direct heterosis at 35-d. Direct additive effect was positively significant ($p<0.01$) for all the traits (21-d), and for shoulder to tail, and length of ear (35-d). Maternal additive effect was negative ($p<0.05$; 0.01) at 21-d. We concluded that NZW bucks should be used to mate CH does to improve body weight and associated body traits at 21-d, and at weaning, while CH does should be favoured to give the best result based on their superior maternal ability at 21-d. Crossing NZW and CH rabbits could lead to increase in individual body weight and associated body traits. This should be of interest to rabbit farmers and consumers.

Table 7 shows the estimate of crossbreeding effects (direct, maternal and heterotic effects) for Body Weight (BW) at weeks 3, 5, and 7, and Daily Gain (DG) at 0-21, 21-35 and 35-49 days, respectively. The results revealed significant ($p<0.05$) differences among the genotypes for BW at week 3, 5, 7 and DG. Breed difference showed significance ($p<0.01$) for all body weight changes except for DG_{35-49}. Direct additive effect was generally positive and in favour of NZW rabbit but showed significant ($p<0.05$) difference only for BW_5 (11.63%) and DG_{0-21} (20.72%). Maternal additive effect was significant ($p<0.01$) for BW_5 (8.95%) and BW_7 (20.36%) while, negative heterotic effect

($p<0.05$) was observed for BW_5 (-23.26%) and BW_7 (-18.01%), respectively. It was concluded that, breed differences exist between the two rabbit strains and this difference mostly favoured NZW strain. This breed difference is a veritable raw material for the genetic improvement of the rabbit breeds taking advantage of crossbreeding.

I got interested in molecular genetics. Starting with blood protein, we evaluated haemoglobin polymorphism in Sudanese Watish sheep imported into Nigeria and how this affected selected body measurements. Blood samples were collected from the sheep and analyzed using cellulose acetate electrophoresis. Results showed that haemoglobin variant did not significantly ($p>0.05$) affect the selected body parameters measured. We concluded that, even though polymorphism existed at the haemoglobin locus of Sudanese Watish sheep; this did not affect the selected body parameters evaluated (Table 8).

Table 6. Crossbreeding genetic effects (linear functions ± SEM) for growth-related traits at pre-weaning and weaning age

	Breed difference	Direct heterosis		Direct additive heterosis		Maternal additive heterosis	
Parameter	NZW x CH	Units	%	NZW x CH	%	NZW x CH	%
21-days							
IBW (g)	35.29*± 15.04	-58.89**± 23.93	-28.12	74.29**± 23.93	35.47	-39.00*± 18.61	-5.20
NTS (cm)	0.08± 0.29	-0.83 ± 0.82	-9.05	2.03**± 0.82	22.14	-1.95**± 0.76	-21.27
STL (cm)	1.37**± 0.39	-3.97**± 1.36	-23.76	4.55**± 1.36	27.23	-3.18**± 1.36	-19.03
HG (cm)	0.79*± 0.37	-2.21**± 0.43	-17.33	3.49**± 0.43	27.37	-2.70**± 0.22	-21.23
TL (cm)	1.17**± 0.42	-2.94**± 1.19	-21.05	3.84**± 1.19	27.49	-2.67**± 1.11	-19.11
LE (cm)	0.78**± 0.16	-0.93*± 0.47	-16.55	1.95**± 0.47	34.70	-1.17**± 0.45	-20.82
35-days							
IBW (g)	75.30**± 17.22	-104.52**± 31.64	-27.29	53.80 ± 31.64	14.05	21.50 ± 26.54	5.62
NTS (cm)	-0.14 ± 0.30	1.02 ± 0.54	9.47	0.22 ± 0.54	2.04	-0.36 ± 0.45	-3.34
STL (cm)	2.58**± 0.41	-1.45 ± 1.04	-6.80	3.35**± 1.04	15.72	-0.77 ± 0.96	-3.61
HG (cm)	0.86*± 0.41	0.69 ± 0.79	4.71	0.35 ± 0.79	2.39	0.51 ±0.68	3.48
TL (cm)	1.03± 0.56	-1.52 ± 0.95	-8.63	1.78 ± 0.95	10.10	-0.75 ± 0.77	-4.27
LE (cm)	0.81**± 0.15	-1.11**± 0.34	-14.14	1.19**± 0.34	15.16	-0.38 ± 0.31	-4.84

*NZW = New Zealand White; CH = Chinchilla; + = (Estimated value/ (NZW + CH)/2) x 100; * ($p<0.05$); ** ($p<0.01$); ± standard error of mean; IBW = Individual body weight; NTS = Nose to shoulder; STL = Shoulder to tail; HG = Heart girth; TL = Trunk length; LE = Length of ear.*

Source: Egena *et al.* (2013)

Table 7: Crossbreeding genetic effects (linear functions ± SEM) for body weight traits

	Body weight (g)			Daily gain (g/day)		
Genotype	BW_3	BW_5	BW_7	DG_{0-21}	DG_{21-35}	DG_{35-49}
Breed difference						
NZW vs CH	39.43**± 2.21	78.48**± 12.12	114.99** ± 5.62	3.48** ± 0.98	1.12 ± 0.87	0.74 ± 0.55
G^I						
NZW vs CH	19.35 ± 13.13	44.34** ± 14.03	15.77** ± 11.68	4.26** ± 1.29	0.72 ± 1.49	0.58 ± 1.45
%$^+$	(9.33)	(11.63)	(3.24)	(20.72)	(0.41)	(-0.55)
M^I						
NZW vs CH	20.08 ± 12.94	34.14**± 7.07	99.22**± 10.24	-0.78 ± 0.83	0.40 ± 1.21	1.32 ± 1.01
%$^+$	(9.65)	(8.95)	(20.36)	(-3.79)	(0.23)	(1.25)
H^I						
NZW vs CH	-10.13 ± 13.13	-88.70**± 14.03	-87.73**± 7.99	-2.44 ± 1.29	-2.24 ± 1.49	0.02 ± 1.45
%$^+$	(-4.89)	(-23.36)	(-18.01)	(-11.87)	(-1.29)	(0.02)

G^I = direct additive effect; H^I = direct heterotic; M^I = additive maternal; NZW = New Zealand White; CH = Chinchilla; BW3 = body weight at week 3; BW5 = body weight at week 5; BW7 = body weight at week 7; DG0-21 = daily gain from 0 -3 weeks; DG21-35 = daily gain from 3 -5 weeks; DG35-49 = daily gain from 5 -7 weeks; SEM = standard error of mean; + = (Estimated value/(NZW + CH)/2) x 100, p<0.01.

Source: Egena *et al.* (2014)

Table 8. Least square means ± Standard Error (SE) of growth-related and udder-related traits of Sudanese Watish sheep as affected by Haemoglobin type

	Genotype			
	AA	AB	BB	P-value
Growth-related traits				
Body length (cm)	68.93±3.08	69.15±4.87	68.50±4.36	0.95
Heart girth (cm)	77.68±6.01	88.20±9.51	87.22±8.50	0.53
Ear length (cm)	17.56±0.76	17.60±1.20	19.22±1.08	0.44
Height at withers (cm)	17.56±0.76	17.60±1.20	19.22±1.08	0.32
Udder related traits				
Teat length (cm)	2.91±0.37	3.10±0.56	3.10±0.37	0.94
Udder length (cm)	12.39±0.37	13.37±2.65	12.45±2.29	0.95
Udder circumference (cm)	33.29±0.37	26.07±6.48	25.90±5.61	0.50
Scrotal length (cm)	26.60±2.61	24.00±4.51	30.00±4.51	0.50
Scrotal circumference (cm)	36.03±4.13	34.00±7.15	42.30±7.15	0.50

AA = haemoglobin AA; AB = haemoglobin AB; BB = haemoglobin BB.

Source: Ilesanmi *et al.* (2016)

This was followed by a study in which we evaluated haemoglobin polymorphism in West African Dwarf goats sampled in Gulu, and Red Sokoto goat and Yankasa sheep sampled in Beji, Niger State, respectively. The Gulu study revealed significant ($p<0.05$) differences influenced by haemoglobin type in body weight (male and female), scrotal length, and scrotal circumference (male), and udder circumference (female) of the goats (Table 9). For the Beji study, haemoglobin type affected ($p<0.05$) body weight, scrotal length and scrotal circumference of male Yankasa sheep only (Table 10).

Table 9. Effect of haemoglobin type on body weight and reproductive parameters of West African Dwarf goats sampled at Gulu, Niger State

	Haemoglobin genotype			
Parameter	AA	AB	BB	AC
Body weight (Kg)				
Male	$10.00^{c}\pm0.84$	$12.67^{b}\pm0.24$	$11.83^{b}\pm0.34$	$17.00^{a}\pm0.84$
Female	$10.00^{b}\pm2.20$	$14.48^{a}\pm0.48$	$13.15^{a}\pm1.10$	$12.67^{ab}\pm1.27$
Reproductive (cm)				
Scrotal length	$8.10^{b}\pm0.62$	$9.13^{b}\pm0.18$	$8.90^{b}\pm0.25$	$10.90^{a}\pm0.62$
Scrotal circumference	$18.00^{b}\pm0.50$	$18.18^{b}\pm0.14$	$18.53^{b}\pm0.20$	$20.00^{a}\pm0.50$
Udder length	8.00±0.66	8.00±0.66	8.70±0.33	7.83±0.38
Udder circumference	$19.80^{ab}\pm1.46$	$20.68^{a}\pm0.32$	$20.53^{a}\pm0.73$	$17.43^{b}\pm0.85$

AA = haemoglobin AA; AB = haemoglobin AB; BB = haemoglobin BB, haemoglobin AC, $p<0.05$.

Source: Musa *et al.* (2016)

We stepped up to evaluating some selected genes in selected farm animals. We started by taking a look at genetic polymorphism at the β-Lactoglobulin (β-LG) gene of three Nigerian indigenous goat breeds (West African Dwarf, Sahel and Red Sokoto), using the Polymerase Chain Reaction-Random Fragment Length Polymorphism (PCR-RFLP) method. We used two restriction endonucleases (Rsal and Mspl). The results revealed the existence of only one polymorphic variant (allele A)

with a gene frequency of 1.0 in all the three goat breeds studied. The amplified products were observed at 120bp and restriction digestion with Rsal revealed just one genotype at the β-LG gene locus. Our conclusion was that, there was absence of polymorphism at the β-LG gene locus of the goats investigated (Table 11). This prompted us to ask the question in another publication that ''Is it possible to obtain zero estimates of genetic diversity? A case study of the Nigerian indigenous goat breeds at the β-Lactoglobulin gene locus'' (Ezewudo *et al.,* 2017). We are still awaiting answer.

Table 10. Effect of haemoglobin type on body weight and reproductive parameters of Red Sokoto (RS) and Yankasa (YS) sheep sampled at Beji, Niger State

	Haemoglobin genotype			
Specie	AA	AB	BB	BC
Body weight (Kg)				
RS-male	15.00±2.20	13.00±1.56	13.29±1.18	11.67±1.80
RS-female	22.80±3.76	23.40±1.88	23.76±1.56	22.17±3.43
YS-male	22.83^{b}±1.24	44.00^{a}±0.00	-	-
YS-female	28.40±0.94	00.00±0.00	-	-
Reproductive (cm)				
RS-Scrotal length	14.00±2.68	12.75±1.89	12.29±1.43	12.00±2.19
RS-Scrotal circumference	22.00±2.68	20.75±1.89	20.29±1.43	20.00±2.19
RS-Udder length	20.00±2.50	17.45±1.04	16.72±1.04	15.83±2.89
RS-Udder circumference	28.80±3.32	29.60±1.66	27.48±1.38	22.50±3.03
YS-Scrotal length	18.83^{b}±1.08	26.00^{a}±0.00	-	-
YS-Scrotal circumference	25.67^{b}±0.67	33.00^{a}±0.00	-	-
YS-Udder length	11.91±0.41	-	-	-
YS-Udder circumference	28.05±0.78	-	-	-

AA = haemoglobin AA; AB = haemoglobin AB; BB = haemoglobin BB, BC = haemoglobin BC, $p<0.05$.

Source: Garba *et al.* (2017)

Table 11. Genotype and allelic frequencies at the β-lactoglobulin gene locus in three indigenous Nigerian goat breeds

Goat breed	N	β-lactoglobulin genotype			Gene frequency		$(\chi^2)^b$
		AA	AB	BB	A	B	
Sahelian	20	20 (1.00)	0(0.00)	0(0.00)	1.00	1.00	Monomorphic
Red Sokoto	20	20 (1.00)	0(0.00)	0(0.00)	1.00	1.00	Monomorphic
West African Dwarf	20	20 (1.00)	0(0.00)	0(0.00)	1.00	1.00	Monomorphic
Total	60	20 (1.00)	0(0.00)	0(0.00)	1.00	1.00	Monomorphic

AA = β-LG AA, AB = β-LG AB, BB = β-LG BB, b = test of Hardy-Weinberg equilibrium

Source: Ezewudo *et al.* (2019)

A similar study assessed the genetic diversity of four Nigerian sheep populations (Balami, Yankasa, Ouda, West African Dwarf). Extracted DNAs from blood samples were also used to study polymorphism at the β-lactoglobulin gene locus using RLFP-PCR process. Results revealed that the percentage polymorphic locus was 100% while Shannon's information index, observed homozygosity, expected heterozygosity, unbiased expected heterozygosity and fixation index were 0.656, 0.516, 0.464, 0.477 and -0.075, respectively. The gene flow (Nm) for all the population was estimated to be 7.65 (Table 12). Phylogenetic analysis of the sheep revealed three clusters (Fig. 6). We pointed out the need for intensified effort to be made in order to prevent the further wearing away of the genetic merit of the sheep populations considering the negative fixation index which is an indication of onset of inbreeding depression (Table 12).

Table 12. Genetic differentiation at the *β*-lactoglobulin gene locus of Nigerian sheep breeds

Population	N	Na	Ne	I	Ho	He	uHE	F	%P	Nm
Balami	16	2	1.992	0.691	0.813	0.498	0.514	-0.631	100	
WAD	20	2	1.980	0.688	0.500	0.495	0.508	-0.010	100	
Yankasa	20	2	1.600	0.562	0.200	0.375	0.385	-0.467	100	
Ouda	20	2	1.956	0.682	0.550	0.489	0.501	-0.125	100	
Mean	19	2	1.882	0.656	0.516	0.464	0.477	-0.075	100	7.65
SE	1.000	0.000	0.094	0.031	0.126	0.030	0.031	0.225	0.000	

SE = standard error, Na = number of alleles, Ne = number of effective alleles, I= Shannon's information i ndex, Ho = observed heterozygosity, He = expected heterozygosity, uHe = unbiased expected heterozygosity, F = fixation index, %P = percentage of polymorphic locus, Nm = gene *flow, WAD = West African Dwarf.*

Source: Abubakar *et al.* (2020)

Fig. 6: Dendrogram showing genetic relationships at the *β*-lactoglobulin gene locus of Nigerian indigenous sheep breeds
Source: Abubakar *et al.* (2020)

We carried out an in-silico amplification of randomly selected male-specific region-Y (MSY) genes. This was to evaluate their possible usage as candidate genes for selection of fertile indigenous bulls for artificial insemination. In-silico PCR is a computational tool used to calculate theoretical Polymerase Chain Reaction (PCR) results, using a given set of primers (probes) to amplify DNA sequences from a sequenced genome or transcriptome. This tool is used to optimize the design of primers for targeted DNA or cDNA sequences. The study examined in-silico polymerase chain reaction amplification of some selected Male Specific region Y (MSY) genes in genome assemblies including Bos_taurus_UMD_3.1.1/bosTau8, ARS-UCD 1.2/bosTau9; BaylorBtau_4.6.1/bosTau7, Bos_taurus_UMD_3.1/bosTau6, and Baylor4.0/bosTau4. The amplification showed that 12 out of 13 selected genes were expressed at an average primer melting temperature of 61.78^{o}C; while salt and annealing oligo concentrations were 50mM and 50nM per reaction, respectively. Out of the expressed genes; 6, 5 and 1 were expressed in genome assemblies

Bos_taurus_UMD_3.1.1/bosTau8, ARS-UCD1.2/bosTau9, and BaylorBtau_4.6. 1/bosTau7, respectively. The study inferred that, the expressed genes are potential genetic markers for selection of fertile bulls, and that the primers used are suitable for *in-vivo* annotation of the genes in the prospective bull selection process for breeding programmes (Sikiru *et al.,* 2020). The actual deployment of these tools is yet to be carried out however, so further details will not be given here.

Oxidative stress is an exclusive biochemical complication affecting reproductive efficiency in animals and anyway this can be attenuated, will increase reproductive performances. Hence, we evaluated *Chlorella vulgaris* (a naturally occurring fungal antioxidant), as a supplement for grower female rabbits. The rabbits were randomly distributed into five experimental groups in a completely randomized design. The control group was fed only a compounded diet, while treatment groups were fed diets containing 40, 60, 80, and 100% *Chlorella vulgaris* biomass, respectively at 500mg per animal body weight (Kg) along with the compounded feed daily. Performance records were obtained, blood collected, and at the end, the uterus, ovaries, and liver were removed from sacrificed animals for analysis. Serum, uterus and liver oxidative stress status were determined, while RNA isolated from the liver and ovaries were used for antioxidant genes expression analysis. Antioxidant gene expression levels were determined using real-time quantitative PCR. Significant difference in relative expression of primary antioxidant genes *sod1* and *gpx1* ($p<0.05$) were observed; however, there was no significant difference in relative expression of *bre* ($p>0.05$) and *ucp1* ($p>0.05$). The study concluded from the outcomes that, supplementation of microalgae *Chlorella vulgaris* led to enhancement and up-regulation of the primary antioxidant genes. Hence, it was

recommended as a dietary supplement for protection against oxidative stress and improved productivity in rabbits and other food producing mammalian species.

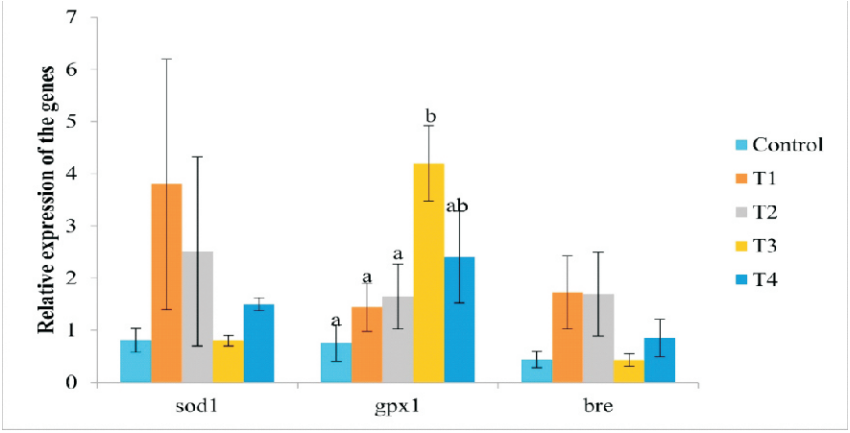

Fig. 7: Relative expression of primary antioxidant genes in liver of the rabbits

Source: Sikiru *et al.* (2019)

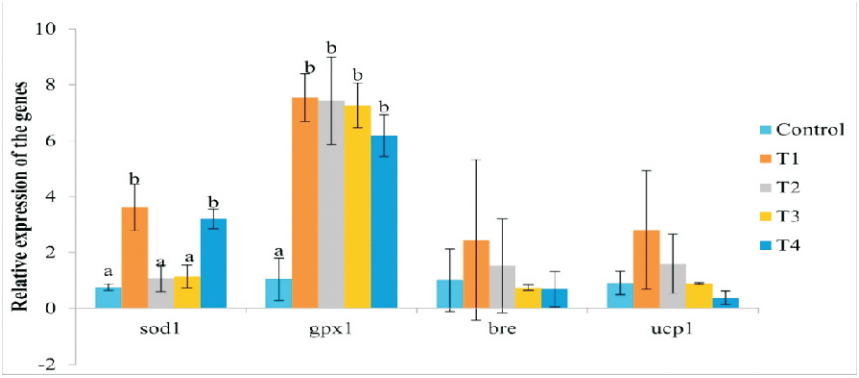

Fig. 8: Relative expression of primary antioxidant genes in ovaries of the rabbits

Source: Sikiru *et al.* (2019)

Growth hormone is concerned with the regulation of growth and many other characters. An investigation of polymorphism at the chicken Growth Hormone (*cGH*) gene of selected chicken breeds (Fulani ecotype, Noiler, FUNAAB Alpha, frizzled feathered and Cobb 500) in Nigeria was carried out by Adigun *et al.* (2020). We extracted genomic DNA from blood samples collected from 49 birds. Amplification of specific DNA fragments at intron 3 of the *cGH* gene yielded a product size of 715bp and this was used to analyze for polymorphism using Polymerase Chain Reaction-Restriction Fragment Length Polymorphism (PCR-RFLP) technique. Banding patterns of the gene investigated, revealed the occurrence of three RFLP variants: TT, CT and CC (Plates 1,2 & 3) with genotype frequencies of 0.449, 0.245, and 0.306, respectively. The allele frequencies of the T and C alleles were 0.469 and 0.531(Table 13), respectively indicating that the C allele was predominant. Chi-square test revealed that the chicken population investigated was in Hardy-Weinberg equilibrium. We concluded that, the presence of observed genetic variations in the chicken growth hormone gene, could be exploited because of its association with economically important traits. This observed genetic variation in the *cGH* gene could be exploited as a candidate gene in marker assisted selection to improve the growth performance of the studied chicken breeds.

Table 13. Frequency of RFLP patterns at intron 3 region of *cGH* gene

Pattern	Genotype	Frequency	Percentage	Gene frequency	Allele frequency
Two bands	CC	15	30.6	0.306	0.531
Three bands	CT	22	44.9	0.449	
One band	TT	12	24.5	0.245	0.469
CC = variant C; CT = variant CT; TT = variant T.					

Source: Adigun *et al.* (2020)

Plate 1. DNA extracted from the chicken breeds

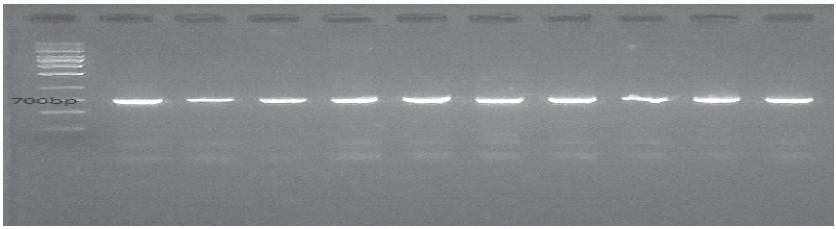

Plate 2. PCR amplified products at intron 3 of *cGH* gene

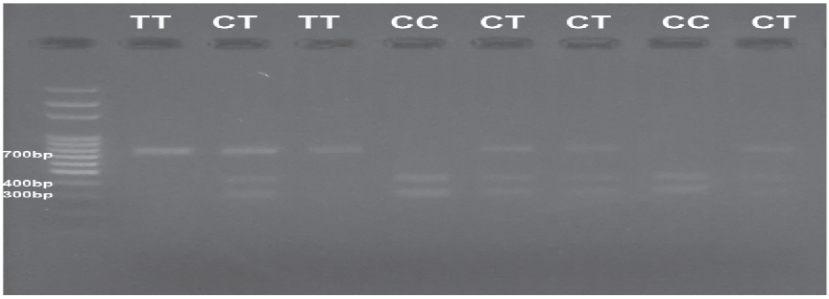

Plate 3. Genotypes amplified products at intron 3 region of *cGH* gene

Source: Adigun *et al.* (2020)

The study also evaluated genetic diversity of the selected chicken breeds. After amplification using PCR, the extracted gene was sequenced and the sequenced data used to evaluate genetic diversity and to carry out phylogenetic analysis. Results showed that the mean number of alleles (Na), mean number of effective alleles (Ne), mean Shannon information index (I), mean observed heterozygosity (Ho), mean expected heterozygosity (He), mean unbiased expected heterozygosity (uHe), mean fixation index (F) and % polymorphic locus were 2.000±0.000, 1.956±0.014, 0.682±0.004, 0.449±0.067, 0.489±0.004,

0.516±0.004, 0.083±0.138 and 100%, respectively. The gene flow (Nm) for all the population was 13.141(Table 14). Phylogenetic analysis divided the five chickens into two broad claves; Noiler and the frizzled feathered occupying one clave, and the Fulani ecotype, FUNAAB Alpha, and Cobb 500 occupying the other clave (Fig. 9). It was concluded that great genetic diversity exists in the chicken breeds which could be exploited for further improvement especially in the more native breeds. This is achievable through crossbreeding with the more distant breeds.

Table 14. Genetic differentiation at the *cGH* gene locus of five chicken breeds

Population	N	Na	Ne	I	Ho	He	uHe	F	%P	Nm
Noiler	10	2.000	1.980	0.688	0.500	0.495	0.521	-0.010	100	
Fulani ecotype	9	2.000	1.976	0.687	0.444	0.494	0.523	0.100	100	
FUNAAB Alpha	10	2.000	1.923	0.673	0.600	0.480	0.505	-0.250	100	
Frizzled feather	10	2.000	1.980	0.688	0.500	0.495	0.521	-0.010	100	
Cobb 500	10	2.000	1.923	0.673	0.200	0.480	0.505	0.583	100	
Mean	**9.800**	**2.000**	**1.956**	**0.656**	**0.516**	**0.464**	**0.477**	**-0.075**	**100**	13.141
SE	0.200	0.000	0.014	0.031	0.126	0.030	0.031	0.225	0.000	

SE=standard error, Na=number of alleles, Ne=number of effective alleles, I=Shannon's information index, Ho=observed heterozygosity, He=expected heterozygosity, uHe=unbiased *expected heterozygosity, F=fixation index, %P=percentage of polymorphic locus, Nm=gene flow.*

Source: Ojimah *et al.* (2020)

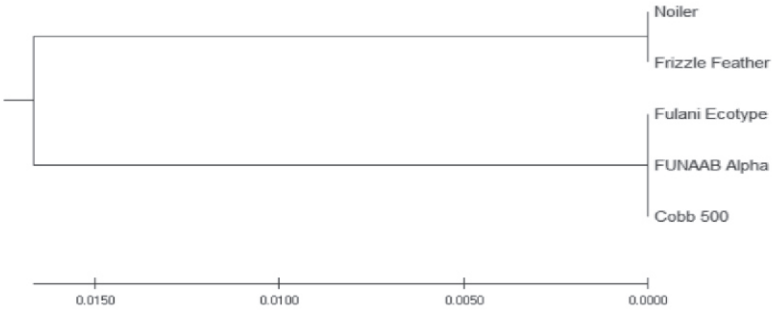

Fig. 9. Phylogenetic analysis of genetic relationship between the chicken breeds at the *cGH* gene locus

Source: Ojimah *et al.* (2020)

I have also researched with my undergraduate and Masters students in one other area of interest; phytogenics. Phytogenics is the use of naturally occurring herbs in the feeding of farm animals. These herbs apart from enhancing palatability and feed intake in animals, have been reported to also have anti-bacteria, anti-fungal, anti-viral, wound healing, anti-inflammatory, anti-arthritic, anti-oxidative, anti-diabetic, anti-tumorigenic, and immunological properties (Hashemabadi & Kaviani, 2008; Franz *et al.,* 2010; Muanda *et al*., 2011; Velasco & Williams, 2011; Kanduri *et al.*, 2013; Alipour *et al*., 2015). These properties make them key ingredients used either as feed additives, or direct fed ingredients. This has great implication for cost, especially to start up farms and resource poor farmers (Kubkomawa *et al*., 2013). Ahsan *et al*. (1999) reported that feed added garlic can upgrade immune performance against Infectious Bursal Disease (IBD) and Newcastle Disease (ND) in poultry. Garlic infusion plays a vital role in the weight gaining efficiency of broilers (Shahriyar & Durraini, 2006).

Sitting on this premise, we designed a study to evaluate the effects of administering extracts of garlic and Aloe vera in water, on the growth performance of broiler chickens. The garlic and Aloe vera extract together with antibiotics control (Sulfaquinoxalina®) were administered at different doses via drinking water consecutively for three days, and alternately at week 1, 3, 5, and 7, respectively. Treatment 1 received commercial antibiotics (Sulfaquinoxalina®) at 2.67g in 4 litres of water. Treatments 2 and 3 each received 0.40mL of garlic and Aloe vera extracts in 4 litres of water (translating to 400ppm. Treatments 4 and 5 each received 0.80mL of both extracts in 4 litres of water (800ppm), while treatments 6 and 7 each received 1.20mL of both extracts in 4 litres of water (1200ppm), respectively. The parameters measured were mean body weight, mean body weight gain, mean feed intake, mean feed conversion

ratio, and mean protein and energy efficiency ratio. No significant ($p>0.05$) differences were observed in all the growth performance parameters measured (starter and finisher phases). Feed conversion ratio, protein and energy efficiency ratios were affected ($p<0.05$) at the finisher phase of the experiment (Table 15). We concluded that doses of 400ppm (garlic) and 800ppm (Aloe vera) extracts via drinking water led to improved feed conversion ratio, protein and energy efficiency ratio of broiler chickens at the finisher phase.

Table 15. Growth performance of broiler chickens administered garlic and Aloe vera extracts

Parameter	T_1 (0AG)	T_2 (400A)	T_3 (400G)	T_4 (800A)	T_5 (800G)	T_6 (1200A)	T_7 (1200G)	SEM
Starter phase								
IW (g/bird)	55.30	55.47	55.13	55.10	55.57	55.33	55.57	0.68
FW (g/bird)	888.91	856.19	808.05	844.72	842.87	946.06	897.18	16.40
BWG (g/bird)	833.61	800.72	752.92	789.62	787.30	890.72	841.62	16.42
WWG(g/bird)	208.40	200.18	188.23	197.40	196.83	222.68	210.49	4.10
WFI (g/bird)	412.08	391.80	390.27	390.36	378.35	457.30	402.73	9.90
FCR (g/bird)	1.98	1.96	2.10	1.98	1.92	2.04	1.91	0.03
PER	2.41	2.43	2.30	2.41	2.48	2.35	2.49	0.03
EER	0.16	0.16	0.15	0.16	0.17	0.16	0.17	0.00
Finisher phase								
IW (g/bird)	888.91	856.19	808.05	844.72	842.87	946.06	897.18	16.40
FW (g/bird)	2198.54	2094.60	2118.87	2029.08	2155.55	2210.64	2044.48	27.70
BWG (g/bird)	1309.64	1238.41	1310.82	1184.36	1312.67	1264.58	1147.30	22.67
WWG(g/bird)	327.41	309.60	327.70	296.09	328.17	316.15	286.82	5.67
WFI (g/bird)	819.62	786.55	797.56	808.28	829.28	964.31	835.83	21.37
FCR (g/bird)	2.50^{ab}	2.54^{ab}	2.44^{a}	2.74^{abc}	2.52^{ab}	3.05^{c}	2.92^{bc}	0.07
PER	2.35^{ab}	2.32^{ab}	2.42^{a}	2.16^{abc}	2.33^{ab}	1.96^{c}	2.03^{bc}	0.05
EER	0.13^{ab}	0.13^{abc}	0.14^{a}	0.12^{abc}	0.13^{ab}	0.11^{c}	0.12^{bc}	0.00

T1 = 0 Aloe vera and garlic, T2 = 400 ppm Aloe v era, T3 = 400 ppm garlic, T4 = 800 ppm Aloe vera, T5 = 800 ppm garlic, T6 = 1200 ppm Aloe vera, T7 = 1200 ppm garlic, SEM = standard error of mean, LS = level of significance, NS = not significant (p>0.05), FCR = feed conversion ratio, PER = protein efficiency ratio, EER = energy efficiency ratio, IW = initial body weight, FW = final body weight, BWG = body weight gain, WWG = weekly weight gain, WFI = weekly feed intake.

Source: Ojimaduka *et al.* (2020)

In ending, I have a story to tell that will probably elucidate why it is not yet *uhuru* for the relationship between animal protein supply and the animal breeder. I had a vision, that of improving

the growth potential of the Fulani ecotype chicken. This came about after one of our papers got published (Egena *et al.,* 2014). In this paper, we optimized two linear regression models which we fronted as tools for selecting and improving the body weight of indigenous chickens of Niger State. When we sent a similar paper on goat to the same journal, it was faulted and the editor challenged us to submit a paper in which we actually used one of the regression models. We took up this challenge; we started by establishing a foundation population of Fulani ecotype chicken from which progenies will be subsequently selected from until we achieved our aim. We realized that growth in farm animals is complex and a function of combinations of factors; basically, the interrelation between body weight and its associated traits (body dimensions). Measurements were, therefore, taken on body weight and five associated morphometric traits at 4, 8 and 12 weeks of age of the birds. Using path coefficient analysis which has the ability to ascertain the direct impact of one variable on another variable, and also, to split correlation coefficient into direct (path coefficient), and indirect effects (exerted via other independent variables), we were able to obtain the part played by each of the body dimension (Table 16). The body dimensions were all observed to make significant direct contributions to the body weight of the Fulani ecotype chicken and with the exception of body length (week 4), and thigh length (week 12), the total combined effects were better than the individual direct effects. We had the choice of either picking a body dimension, or to select all the traits together in a bid to improve the chicken.

So, we went further to generate predictive equations relating the body dimension traits to body weight at 4, 8, and 12 weeks, respectively (Table 17). Shank length showed better R^2 value (0.807, 0.834 and 0.871, respectively) at the 4^{th}, 8^{th}, and 12^{th} week. The equation models at these weeks were, therefore, chosen to be used as selection indexes to aid improvement of body weight. Unfortunately, we could not proceed from here as we were soon

faced with paucity of funds to keep the first generation to sexual maturity and subsequent mating to bring up another generation. We lost the birds to hunger. We are hoping to one day revisit it again seeing how poor our infrastructure is concerning genomic selection which would have given us a short cut to achieving our aim.

Table 16. Direct and indirect effects of body measurement traits measured on body weight of Fulani ecotype chicken at 4th, 8th, and 12th week

		Indirect effects				
Trait	BL	BG	WL	SL	TL	Total
Week 4						
BL	**1.04***	0.45	0.57	0.73	0.00	1.75
BG	0.57	**0.81***	0.50	0.49	0.00	2.37
WL	0.70	0.49	**0.84***	0.78	0.00	2.81
SL	0.72	0.37	0.62	**1.06***	0.00	2.77
TL	0.42	0.42	0.54	0.66	**0.00ns**	2.04
Week 8						
BL	**8.49***	3.94	0.79	3.44	2.48	10.65
BG	4.11	**8.14***	1.67	3.77	3.78	13.33
WL	1.97	3.99	**3.40***	3.55	4.14	13.65
SL	4.97	5.23	2.05	**5.87***	4.70	16.95
TL	3.10	4.53	2.07	4.06	**6.79***	13.76
Week 12						
BL	**2.58***	14.20	8.34	0.83	17.44	40.81
BG	1.19	**30.86***	3.52	0.36	0.74	5.81
WL	1.73	8.73	**12.45***	0.83	19.1	30.39
SL	2.03	10.43	9.73	**1.06***	20.1	42.29
TL	1.57	0.80	8.30	0.74	**28.63***	11.41

Bold *items are direct effects.BW = body weight, BL = body length, BG = breast girth, WL = wing length, SL = shank length, TL = thigh length, * = significant (p<0.05), ns = not significant (p>0.05).*

Source: Yusuf *et al.* (2017)

Table 17. Predictive equations relating morphological traits of Fulani Ecotype chicken to body weight at 4, 8, and 12 weeks

Trait	Regression equation	SEM	R2
Week 4			
BL	BW=0.00000074+1.037BL	0.34	0.759*
BG	BW=0.0000012+0.812BG	0.42	0.646*
WL	BW=0.00000015+0.84WL	0.35	0.770*
SL	**BW=0.0000011+1.0559SL**	**0.33**	**0.807***
TL	BW=0.0000010+0.006TL	0.55	0.082
Week 8			
BL	BW=0.0000220+8.495BL	15.9	0.678*
BG	BW=0.0000500+8.139BG	14.9	0.722*
WL	BW=0.2520000+3.398WL	17.72	0.574*
SL	**BW=0.0000560+5.873SL**	**11.93**	**0.834***
TL	BW=0.0000120+6.789TL	12.73	0.809*
Week 12			
BL	BW=0.0000067+2.583BL	12.52	0.804*
BG	BW=0.000024+30.858BG	18.55	0.474*
WL	BW=0.000016+12.447WL	10.48	0.867*
SL	**BW=0.000058+1.060SL**	**10.34**	**0.871***
TL	BW=0.0000074+28.631TL	14.26	0.736*

** = p<0.05, BW = body weight, BL = body length, BG = breast girth, WL = wing length, SL = shank length, TL = thigh length, R2 = coefficient of determination.*

Source: Yusuf *et al.* (2017)

CONCLUSION

The relationship between animal protein security and the animal breeder is a straight one; the animal breeder brings about animal improvement. This improvement leads to increase in the productivity of farm animals, with a concomitant increase in animal protein supply. This relationship will enhance animal protein security.

This is highly achievable in Nigeria, if there is political will on the part of government, private sector commitment, and farmers associations involvement. Proper funding of research by all stakeholders will ensure adequate supply of animal protein. This is all the more important in growing children for proper mental and physical development; also, in pregnant women. Our country will continue to be a beggar nation in as much as we do not get this aspect of our national life right. It will not be wrong to say, therefore, that animal protein security equals national security.

RECOMMENDATIONS

The main task of the animal breeder, is to bring about improvement in animal productivity. In order to achieve this, the following are recommended:

1. Funding of research is a must and this should not be left for the government alone. Most of the recent advances made in the area of animal breeding, came through funding of research into particular animals, and particular traits of economic importance to farmers association, consumers and businessmen/women. These group of people can equally do the same in Nigeria.
2. The research environment keeps changing. We are in the era of genomic selection making use of linkage equilibrium to improve farm animals. There is need to provide equipment needed to make this work. This equipment is not beyond the realm of possibility for a nation such as ours.
3. There is need to encourage record keeping by our livestock farmers. Such records are important raw materials for both quantitative and genomic study of traits of economic importance.
4. Research findings still needs to get to the end users when they become available. There is need for synergy, therefore, between the researchers and the extension arms of the national, state and local government departments of agriculture. This way, farmers and other stakeholders are made aware of what is coming out from the research field.
5. Government policy is a great driver of increased productivity. The share of the national budget that goes to animal production is not only meagre, but outright discouraging. Animal production is not all about a few thousand cattle criss crossing about the country looking for grazing with all the

attendant problems attached to it. Neither, is it all about the provision of drugs for prevention of disease outbreaks and for curative purposes. Government policy should ensure the production of a "super cow" for instance for increased milk production from our indigenous cattle, indigenous chickens that can measure up to the exotic ones in meatiness and egg production ability etc. it is possible, we have the human resources.

6. There is need for training and retraining especially in the area of emerging technology. The lot of the animal breeder should not be about reading of breakthrough findings from other climes. We should train our people, provide them with the wherewithal so that they too can make meaningful contribution to the provision of qualitative animal protein supply.
7. Should we decide to get it right, there will be need for support services in the area of processing, haulage, storage and proper marketing, electricity supply etc. They will all play critical roles in ensuring that what is produced is not wasted, but eventually gets to the final consumer fresh and at competitive prices.
8. There is need to encourage young animal scientists to venture into the field of animal breeding and genetics. What we have presently in terms of number is drastically not enough.
9. Finally, I seriously advocate for the unbundling of NAPRI into several animal research institutes saddled with the responsibility of carrying out research into particular farm animals. Hence, we need a separate research institute for each of the following: Poultry, Cattle, Sheep, Goat, Pig, Rabbit, and even the other fringe animals playing critical roles in animal protein supply (Snail, Guinea pig, Grasscutter, Bee).

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My Wife and Children
I wrote this poem for you some years ago my darling wife;

My darling
An exotic desert plant
Drills her sap from *terra firma*
Her flowers extrude an aroma
Which ignited the trip
The journey being well made
The missing rib found
She is home to stay.

Still relevant today. Thank you for bearing with my periodic excesses and in believing in me. I remember your encouragement at the onset of my University career when paying for accepted papers meant a hold back on some basic necessities. Thank you for advice given at opportuned times. You have given me four beautiful children who have coloured both our lives; Stephenie Ojochegbe Odunayo, Shalom Ufedojo Boluwade, Shanna Chubiyojo Fikayomi, and Samuel Ugbeje Ayokunle. I pray God's mighty reward and keeping upon you.

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'Praise the Lord, O my soul,
And all that is within me,
Praise His Holy name'.

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A Brief Profile of the Inaugural Lecturer

Professor Acheneje Stephen Sunday Egena was born on the 23rd of June, 1968 to the family of Late Prince Stephen Anaja Egena and Mrs. Celina Egena and hails from Ajadafo, Oganenigu, Dekina Local Government Area of Kogi State. He had his Primary School in many schools occasioned by the frequent transfer of his father; he eventually completed his Primary School at LGEA Primary School, Makurdi in 1981. He proceeded to the prestigious Government College, Makurdi for his Secondary School education from 1981-1986. Thereafter, he was at the School of Basic Studies, Makurdi from 1986-1988 for his A 'levels majoring in Biology, Chemistry, and Physics for his Interim Joint Matriculation Board (IJMB) Certificate. He gained admission in 1989 into the Federal University of Agriculture, Makurdi (FUAM) and graduated in 1994 with a B. Agric. Degree, Second Class Upper Division in Animal Production. From 1994-1995, he served the mandatory one year National Youth Service Corps, as an agricultural science teacher and sports master at the Ugbahara High School, Ikun, Biase Local Government Area, Cross River State.

He took up appointment with El-Amin International School, Minna in 1996. He was there from January, 1996 to December, 2005. He was Agricultural Science Teacher, Head of Department (Science), Chairman Sports Committee, and finally, Vice Principal Junior Secondary School at various times. Within that period, he went for his Master Degree in Animal Production with specialization in Animal Nutrition at the Federal University of

Technology, Minna from 2001-2004. This was capped by a PhD Degree in Animal Production with specialization in Animal Breeding and Genetics from the same University in 2012. He is also a holder of a Postgraduate Diploma in Education (PGDE) certificate from the National Teachers Institute (NTI), Kaduna.

Professor Egena joined the services of the Federal University of Technology, Minna on 9th November, 2006 as an Assistant Lecturer and rose through the ranks through dint of hard work to become a Professor of Animal Production (Animal Breeding and Genetics) on 1st October, 2018. He has held several positions of responsibility in the University such as: 500 Level Adviser (2006-2007); Departmental examination Officer (2007-2011); Adviser to Nigerian Society for Animal Production Students; NSAPS (2007-2015); 300 Level Adviser (2011-2014); Departmental Turnitin Officer (2013-2015); Departmental Postgraduate Coordinator (2015-2019); Adviser to the National Association of Agricultural Students (2013-2017); member, University Sports Committee (2008-to date); member, University Web Content Committee (2013-to date); member, Departmental Accreditation Team for National University Commission (NUC) and Nigerian Institute of Animal Science (NIAS) accreditation exercise (2016-2017); Chairman, Departmental Accreditation Committee for NIAS and NUC (2019 to date); member, Committee to Investigate Misappropriation of Funds by NAAS Executives (2006); member, Committee to Investigate Misappropriation of Funds by NAAS Treasurer (2010); member, Committee to Investigate Cases of Conducting Practical in First Bank Lecture Theatre, Student Protest and

Theft of Projector from Caverton Lecture Theatre (2018); and member, Committee to Investigate a Case of Examination Leakage in the School of Agriculture and Agricultural Technology (2019). He also acted as an ad hoc member, Students Union election (2016-2017). He was a member of the Departmental Farm Committee up till 2020. He is currently, a member of the National Advisory Committee on the use of Nigerian Animal Genetic Resources.

He has served as external examiner to the University of Limpopo, South Africa (2013-2015), University of South Africa, UNISA (2017), and Ahmadu Bello University, Zaria (2019). He has been involved in some national and international linkages such as; the development of a course module (Animal Breeding and Genetics) for 300 Level Students, Department of Agriculture, Animal Health and Human Ecology, University of South Africa; UNISA (2009), as well as peer review for promotion of three candidates for the National Research Foundation, South Africa (2013, 2014).

Professor Egena is a member of some professional bodies, namely: Animal Science Association of Nigeria (ASAN), Nigerian Society for Animal Production (NSAP), NIAS, and World Poultry Science Association (WPSA). He has attended several conferences locally and internationally, supervised many students cutting across all the strata of the University system, and published over 100 papers nationally and internationally in reputable journals and proceedings. He has also offered academic support services to several local, national, and international journals, and has attracted several grants to the University.