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13th INAUGURAL LECTURE

TOPIC:

ANIMALS AND US: THAT ALL MAY LIVE WELL- THE QUEST FOR ANIMAL WELFARE

by

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RED HALL
COLLEGE OF HEALTH SCIENCES,
BOWEN UNIVERSITY, IWO

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Staff members and students
My Lord Spiritual and Temporal
Distinguished family members, friends, and guests
Gentlemen of the press and media crew
Ladies and Gentlemen

1.0 Introduction (The making of an Animal physiologist and welfare scientist)

"To God be the glory, great things he hath done". Firstly, I acknowledge the grace of God in my life for the privilege he has given me to stand before you today 23rd May 2024 to deliver this inaugural lecture the 13th in the history of Bowen University, 8th in the College of Agriculture, Engineering, and Science, 7th in the former Faculty of Agriculture, 5th in the current Agriculture Programme and 2nd in Animal Science and Fisheries Management Unit of the Programme.

Secondly, we need to understand that a professorial inauguration, as is being done here, today, is not merely an academic ritual. It is a reflection of our commitment to excellence, a tribute to the power of knowledge, and a testament to the transformative impact of research and education. Therefore, this gathering is a remarkable one and I thank the Vice-Chancellor for this opportunity.

Standing here before you is a lad who purposed to be a medical doctor by parental wishes but through divine arrangement got admitted into the University of Ife (now Obafemi Awolowo University, Ile-Ife) on 14th of December, 1984 to study Animal Science. My academic sojourn and experience at Obafemi Awolowo University, Ile-Ife, brought me closer to domestic animals. That formed the bedrock of my decision to be a practicing livestock farmer in life. After graduation, I was posted to the then Bendel State University (now Delta State University), Abraka Campus for my NYSC in 1990. Upon resumption, the then Head of the Department of Agricultural Education; Dr Agwubike warmly accepted me and quickly allocated me an office and courses to teach and there I got christened into academic life.

After the service year, I returned to my hometown in September 1991. I was employed as a PTA teacher at St.Anthonys' College, Ikoyi, Osun State in October 1991 from where I was appointed as a Farm Manager by an Ibadan-based construction company with a farm site at Ilora Farm Settlement in May 1992. I spent four months there before I got another job as a Livestock Supervisor at Folawiyo Farms, Ilora in September 1992 where I worked for eight years. I broke my service between October 1995 and March 1997 to pursue my master's Program at the University of Ibadan. My stay at Folawiyo Farms baptized me into livestock farming.

Mr Vice-Chancellor sir, I joined Bowen University on April 23rd, 2003 as the pioneer farm manager, and I worked with the academic staff I met on the ground to establish the teaching and research farm for the then Faculty of Agriculture under the Deanship of Prof Tewe. I was converted to an Assistant Lecturer in the Department of Animal Science and Fisheries Management of Bowen University on April 1st, 2005, under the Deanship of Prof. Aduayi and the academic journey continued on the right platform. In the last two decades at this University, I served as Warden for Luke Hall for four years, Coordinator of the University park and garden unit for eight years (2005-2013), Coordinator of Summer School (now extended Remedial Programme) for three years (2016-2019), Acting Director of General Studies Unit (GST) for two years (2018 &2019) and

Postgraduate Programme Coordinator for Agriculture from 2019 till date.

Mr. Vice-Chancellor sir, permit me to mention here that the title of today's Inaugural Lecture **“Animals and Us: That All May Live Well- The Quest for Animal Welfare"** radiates around my innate passion for animals, my training at undergraduate and postgraduate levels, my close interactions with animals at farm level and my love for humanity.

2.0 Definition of concepts

2.1. What Are Animals?

Animals are one of the most diverse and fascinating groups of organisms on earth. They are multicellular, eukaryotic organisms belonging to the kingdom *Animalia*. They constitute a vital part of our planet's biodiversity, showcasing a remarkable array of species with unique adaptations, behaviors, and ecological roles (Holland, 2011).

2.2 Classification of Animals

Animals can be classified based on shared characteristics, evolutionary relationships, and distinctive features into;

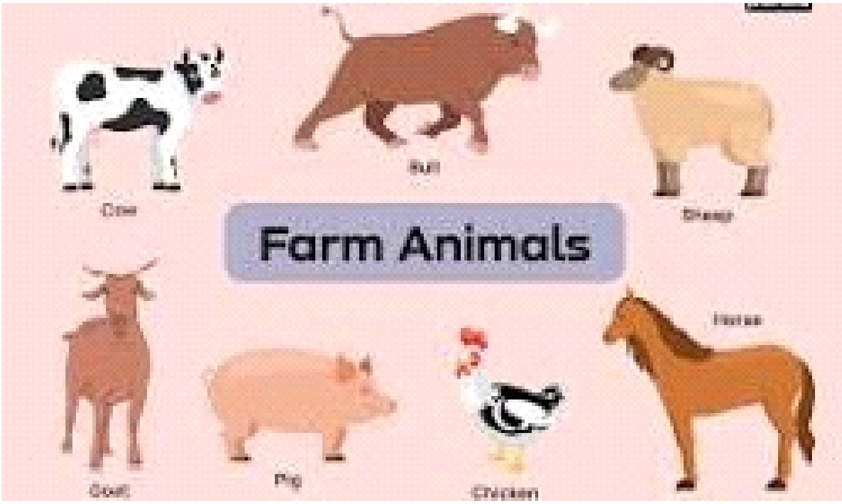
1. **Mammalia (Mammals)**: Mammals are characterized by several distinguishing features, including the presence of hair or fur, mammary glands for nursing their young, and a warm-blooded metabolism. They exhibit a wide range of adaptations, from the flying abilities of bats to the aquatic lifestyle of whales (Gans and Bell, 2001)
2. **Aves (Birds)**: Birds are vertebrates with feathers, beaks, and egg-laying abilities. They are known for their incredible diversity, with adaptations for flight, and efficient respiratory systems (Binod, 2023).
3. **Reptilia (Reptiles)**: Reptiles, including snakes, turtles, and lizards. They are ectothermic (cold-blooded) vertebrates. They are characterized by scales, laying of shelled eggs, and

a relatively simple circulatory system (Lewbart, 2019)

4. **Amphibia (Amphibians)**: Amphibians, such as frogs and salamanders, are vertebrates with a dual life: aquatic larvae and terrestrial adults. They typically have moist, permeable skin and undergo metamorphosis during their life cycle (Semple and Dixon, 2017).
5. **Actinopterygii (Ray-finned Fishes)**: Ray-finned fishes are characterized by their bony skeletons and fins supported by rays (Malabarba and Malabarba, 2020).
6. **Insecta (Insects)**: Insects make up the largest class within the arthropods. They are characterized by a segmented body, exoskeleton, and three pairs of legs. (Britton, 2017).
7. **Arachnida (Arachnids)**: Arachnids, including spiders, scorpions, and ticks, have two main body parts and four pairs of legs. They are predominantly terrestrial (Jonathan and Roberts, 2001).
8. **Mollusca (Mollusks)**: Mollusks, such as snails, clams, and octopuses, are characterized by a soft body, often protected by a hard shell. (Claudio, 2022).
9. **Echinodermata (Echinoderms)**: Echinoderms, including starfish and sea urchins, have a unique five-part radial symmetry. They possess a water vascular system used for locomotion and feeding (David and Mooi,1998).
10. **Chondrichthyes (Cartilaginous Fishes)**: Cartilaginous fishes, like sharks and rays, have skeletons made of cartilage rather than bone. They are known for their predatory behaviors and adaptations for marine environments (Stevens, 2011).

However, for ease of description, animals can be classified into terrestrial (found on the surface of land) and aquatic (found inside water). Terrestrial animals can be further classified into wild animals (inside the wild) and domestic animals (living with humans). Domestic animals can also be divided into ruminant (polygastric) and non-ruminant (monogastric) animals. Ruminant animals can be divided into large and small ruminants. Examples of large ruminants are cattle, donkeys, camel, ass while sheep and goats are examples of small ruminant animals (Babayemi, 2020). Non-ruminant animals include poultry, rabbits, and swine. Ruminant and non-ruminant animals are generally known as *“livestock”* because *“they are stock of animals that support human lives”*.

Figure 1: Types of farm animals



Currently, Nigeria's livestock population is estimated to be about 22.3 million cattle, 53 million sheep, 99.8 million goats, 426 million poultry (chickens, ducks, turkeys,) and 12 million pigs spread across the six geopolitical zones of the country (Alabi et al., 2023).

2.3 Importance of Domestic Animals and Their Productions to Humanity

Mr. Vice-Chancellor sir, permit me as a matter of emphasis to mention some of the importance of domestic animals to humanity. Domestic animals have played a vital role in the development and sustenance of human societies throughout history. Their contributions encompass a wide range of essential resources, services, and support systems that have significantly shaped human civilization as enumerated below:

1. Food Production

Domestic animals are a primary source of food for humanity. Livestock such as cattle, sheep, goats, pigs, and poultry provide meat, milk, and eggs, which are key components of the human diet (Guyonnet, 2011; Kevin, 2016; Oladejo et al., 2021). The production of food from animal origin contributes to global food security and nutrition, providing essential proteins, vitamins, and minerals. Milk and dairy products, including cheese, butter, and yogurt, are staples in the human diet. Domestic animals such as cows, goats, and sheep are primary sources of milk production, providing a valuable source of calcium, protein, and essential nutrients (Brown et al., 2022).

2. Agricultural Labor

Domestic animals have been used for plowing fields, transporting goods, and powering machinery. Even in modern times, in some regions, animals like oxen and horses continue to support small-scale agriculture, particularly in areas with limited access to mechanized farming (Zantsi and Besta,2019).

3. Fiber and Textiles

Certain domestic animals, such as rabbits, sheep, and goats, are raised for their wool and hair. These fibers are used to produce textiles, clothing, and other fabric-based products. The textile industry relies on domestic animals to supply raw materials for a wide range of goods (John, 2021).

4. Leather and Hide Production

Animal hides and skins have been used for centuries to produce leather, which is widely utilized in the manufacturing of shoes, clothing, accessories, and upholstery. Leather production is a significant global industry, providing economic opportunities and valuable materials (Wilson et al., 2012).

5. Companionship

Beyond their direct contributions to food security, domestic animals also offer companionship and support. Cats and dogs, for instance, have served as loyal companions and guardians for centuries. Horses have also been used in sports (Belk, 1996).

6. Biodiversity and Ecosystem Services

The management of domestic animal populations has indirect effects on biodiversity and ecosystem services. Grazing animals can influence vegetation patterns and contribute to landscape diversity (Mysterud et al., 2019). They also play a role in nutrient cycling and land management.

7. Economic and Cultural Significance

The production of domestic animals and their products has a profound economic and cultural significance in many societies specifically in our nation. Livestock farming and related industries provide employment, and income, and contribute to rural economies (Eicher, 1990). Additionally, animals and their products often hold cultural and symbolic value in various traditions and practices.

2.5. Problems Facing Livestock Production in Nigeria

Mr. Vice-Chancellor sir, even though livestock production is a critical component of Nigeria's agricultural sector, however, it faces several challenges that hinder its growth and potential to meet the increasing demand for animal products in the country. Some of these challenges are:

(i) inadequate infrastructure and facilities (Nwafor and Adeoluwa, 2013)

(ii) inadequate extension services (Mengistu et al., 2021),

(iii) disease outbreaks (Dransfield, 1991)

(iv) limited access to credit facilities and funding (David-west, 1983)

(v) inadequate breeding programs (Zaibet et al., 2020, Oladejo et al, 2013)

(vi) expensive feed ingredients (Bembridge, 1979)

(vii) inadequate land for grazing and ranching (Eeswaran et al.,2022; Oladejo et al., 2023)

(viii) climate change and environmental degradation (Hoffman, 2013; Kratli et al., 2013; Amole and Ayantunde, 2016)

(ix) limited access to the market (Ajani et al., 2014)

(x) policy and regulatory challenges (Ayantunde et al., 2014)

(xi) poor animal husbandry (Wilson, 2018).

Addressing these challenges is essential for the sustainable development of livestock production in Nigeria. Mr Vice-Chancellor sir, these challenges stimulated my research interests in the area of animal physiology and much more specifically animal welfare with a critical look at the interactions between animals and human beings.

3.0 Animals and us (the pathway to my research interests)

Animals and humans are inseparable! According to the Holy Bible, upon the creation of the earth, God said as recorded in the book of Genesis Chapter 1 verses 28 to 30;

28" *And God blessed them, and God said unto them, Be fruitful, and multiply, and replenish the earth, and subdue it: and* *have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth (animals).*

[29] *And God said, Behold, I have given you every herb bearing seed, which is upon the face of all the earth, and every tree, in the which is the fruit of a tree yielding seed: to you, it shall be for meat.*

[30] *And to every beast of the earth, and to every fowl of the air, and to everything that creepeth upon the earth, where there is life (Animals), I have given every green herb for meat: and it was so." (King James Version)*

Therefore, domestication has brought animals and us together right from the time God created the earth, and the earnest expectation is that the animals be well taken care of although they will eventually become our food.

Mr.Vice-Chancellor sir, my academic voyage has made me realize that a***nimal physiology, health, and welfare*** are interconnected aspects of animal well-being, each influencing and being influenced by the others.

Animal physiology refers to the study of how animals function biologically, including their organs, systems, biochemical processes, and physical functions (Bateson, 1997). Physiology plays a critical role in determining an animal's health and welfare by influencing factors such as metabolism, reproduction, and stress response (Broom and Johnson, 1993).

Animal health encompasses the physical and mental well-being of animals, including their freedom from disease, injury, and pain (Broom,2014). Healthy animals are better able to cope with stressors and maintain homeostasis, which is essential for overall health and welfare (Dawkins, 1980).

Animal welfare refers to the state of an animal's well-being, including its physical health, mental state, and ability to express natural behaviors (Fraser, 2008). The fundamental idea underlying animal welfare is the recognition that animals are sentient beings capable of experiencing pleasure, suffering, and a range of emotions and that they deserve to be treated with respect, care, and consideration (Fraser, 2010).

Animal physiology, health, and welfare are closely interconnected. An animal's physiological state, such as its metabolic rate or stress response, can affect its health and welfare. For example, chronic stress can weaken the immune system and make animals more susceptible to disease. Conversely, poor health can lead to welfare issues, such as pain or discomfort.

I would like to emphasize here that understanding the relationship between animal physiology, health, and welfare is essential for providing optimal care for the animals.

3.1 Good animal welfare versus bad animal welfare

Mr Vice-Chancellor sir, I will briefly go through the difference between good and bad animal welfare.

Good Animal Welfare entails:

Good Health and Nutrition: Animals with good welfare have access to a balanced diet, clean water, and appropriate veterinary care to maintain their health. (Albright and Arve, 1997).

Comfortable Living Conditions: Animals should have access to comfortable living conditions, including appropriate shelter, bedding, and space to move around (Figure 2). (Martin and Bateson, 2007).

Freedom from Pain and Distress: Animals should be free from pain, injury, and disease. Good welfare practices include providing pain relief for procedures such as castration or dehorning and prompt treatment for injuries or illnesses (Price, 2008).

Ability to Express Natural Behaviors: Animals should be able to express their natural behaviors, such as foraging, socializing, and nesting (Figure 3). Good welfare practices include providing enrichment and space for animals to engage in these behaviors. For instance, hens that can scratch in the dirt and lay their eggs in private nests have better welfare than those kept in cages (Hurnik et al., 1995).

Positive Human-Animal Relationships: Animals should be treated with kindness and respect by humans. Good welfare practices include gentle handling, positive reinforcement training, and avoiding practices that cause fear or distress. For example, dogs that are trained using positive reinforcement methods have better welfare than those trained using punishment (Houpt, 2011).

Bad Animal Welfare entails:

Poor Nutrition: Malnutrition or starvation due to inadequate access to food or poor quality feed constitutes bad welfare. For example, pigs that are not provided with enough food may become emaciated and weak (Burkhardt, 2005).

Inadequate Living Conditions: Overcrowded, unhygienic, or unsafe animal houses will lead to bad welfare. For instance, cows that are kept in cramped, dirty feedlots with no access to pasture have poor welfare (Wood-Gush, 1971).

Pain and Distress: Pain, fear, or distress due to injuries, disease, or stressful conditions will result in bad welfare. For example, goats that are kept in small cages for long periods without exercise or socialization may suffer from stress and anxiety (Wood-Gush, 1983).

Restriction of Natural Behaviors: The prevention of animals from expressing natural behaviors is a form of bad welfare. For instance, chickens that are raised inside cages prevent them from engaging in natural behaviors such as dust bathing, perching, and flying (Coleman and Hemsworth, 2014; Alabi, 2018).

Negative Human-Animal Relationships: Subjecting animals to harsh treatment, abuse, or neglect by humans will lead to bad welfare. For example, cattle that are usually beaten or trained using cruel methods have poor welfare (Brajon et al., 2015).

Humans need to prioritize good animal welfare in their interactions and practices with animals to ensure their well-being and quality of life.

Figure 2: Broilers raised on aviaries

Figure 3; Chickens on free-range

Mr. Vice-Chancellor sir, many will be wondering why we need to care so much for animals that we will eventually kill and eat. It is highly important to emphasize that animals deserve the best treatment. No wonder Yoruba people say *"eran ti a o pa je, laa bo"* meaning "animals that we want to kill and eat must be well fed. Another Yoruba adage says " *oju ni maalu n ro, obe o dara lorun* " meaning " cattle have no choice, a knife is not good at the throat". It has also been established that passion for animals will ultimately lead to passion for human beings. He who knows how to handle animals passionately will be kind to humanity (Ajzen and Fishbein, 1980). No wonder animal scientists and livestock farmers are always passionate, peace-loving, and kind not only to their animals but to fellow human beings!

Meanwhile, the need to imbibe welfare ethics for farm and laboratory animals is still a mirage in developing countries, Nigeria inclusive. This may be attributed to poor economy and standard of living (Alabi et al., 2013), lack of awareness on issues of animal welfare, and non-enforcement of animal welfare laws. Many are looking at animal welfare issues not as a necessity now that many developing countries are battling with economic and political crises. Culturally, animals are not often given priority in terms of care. No wonder a Yoruba adage says "*eniyan o ri ibi sun, aja n han oorun"* (human being has not gotten a space to sleep, a dog is snoring"), Nevertheless, we can not afford to handle our animals carelessly hence my research interests to create awareness on issues of animal welfare in developing countries.

Mr Vice-Chancellor sir, kindly permit me, therefore, to mention some of the importance of animal welfare and its science to livestock production.

3.2 Importance of Animal Welfare Science

Animal welfare science plays a pivotal role in modern animal production systems by promoting ethical, sustainable, and economically efficient practices. The integration of animal welfare considerations into livestock production has far-reaching benefits as highlighted below;

1. Enhanced Animal Health and Productivity

Animal welfare science enables producers to create environments and management practices that reduce stress, disease, and injuries, ultimately enhancing the health and productivity of animals (De Reu et al., 2005).

2. Improved Product Quality

Incorporating animal welfare science into production systems helps ensure better product quality, as animals are more likely to thrive and produce high-quality meat, milk, and eggs (Grandin, 1996).

3. Long-term Sustainability

Ethical treatment of animals contributes to the long-term sustainability of the industry by reducing resource wastage and enhancing production efficiency (Broom, 2010).

4. Reduced Risk of Disease Transmission

Animal welfare practices that reduce stress and ensure proper animal husbandry can lead to a decrease in the transmission of diseases within and between herds or flocks. This can significantly reduce the need for antibiotic use and minimize the risk of zoonotic diseases (Hemsworth et al., 2019).

5. Ethical Responsibility

Animal welfare science influences consumer choices. As consumers become more concerned about the ethical treatment of animals, they prefer to purchase products from producers who adhere to animal welfare guidelines (Henchion et al., 2014). Producers who prioritize animal welfare can improve their reputation and marketability. Also, the use of animals for research purposes is being guided by relevant information provided by the advocates for animal welfare and this is a global phenomenon to protect the animals.

Mr Vice-Chancellor sir, the only way we can know how animals are faring is through their behaviors. Animals can not talk as I am doing now but they do communicate behaviorally within and across species, knowledge of this is important to accurately assess their welfare status.

3.3 Animal Welfare and Animal Behavior

Animal behavior refers to the actions, activities, and responses exhibited by animals to internal and external stimuli.

Types of Animal Behavior

Animal behaviors are classified into different categories based on their characteristics, functions, and underlying mechanisms. The following are some of the identified types of animal behavior:

1. Innate Behaviors

Innate behaviors are instinctive actions that are genetically programmed and do not require prior learning. They are often stereotypical and automatic responses to specific stimuli. Actions such as; feeding, exploratory, social, territorial, defensive, rest and sleep, communication, and the courtship dances of birds, are also innate and species-specific (Lorenz, 1935).

2. Learned Behaviors

Learned behaviors are acquired through experience, exposure to the environment, and purposeful training. These behaviors are flexible and can be modified based on individual experiences. Examples are, habituation, classical conditioning, and operant conditioning (Burman et al., 2008).

3. Complex Behaviors

Complex behaviors involve a sequence of actions and often serve specific functions related to survival, reproduction, or social interactions. For example, migration is a complex behavior observed in many species, including birds and fish. It involves long-distance travel to access resources or suitable breeding grounds (Alerstam, 2011).

4. Communication Behaviors

Communication behaviors involve the transmission of signals or information between individuals within a species. These signals can be visual, auditory, chemical, or tactile. Birdsong is a classic example of auditory communication (vocalization) in birds, used for mate attraction and territory defense (Catchpole and Slater, 2008). Cockcrow is also an example of auditory communication among chickens to announce the new dawn. Bucks (he-goats) vocalize when hungry and when to mate in unique but different ways and so also chickens. Chemical communication is evident in the pheromones released by many animals to convey information about reproductive status or territory (Wyatt, 2003).

5. Social Behaviors

Social behaviors involve interactions between individuals of the same species. These interactions can include cooperation, competition, mating, and the establishment of hierarchies. Dominance hierarchies are evident among cattle, rabbits, and pigs reared under extensive system or semi-intensive systems of production. The younger animals within the flock follow the elderly ones to graze and take instructions from them. This is also applicable to the choice of mating partners by the males within the flock with the elderly ones taking the lead. This helps to maintain order within a group (Broom and Fraser, 2015).

6. Reproductive Behaviors

Reproductive behaviors are crucial for the successful breeding and production of farm animals. These behaviors encompass a range of actions and interactions that are vital for mating, fertilization, and the rearing of offspring. Reproductive behaviors include:

i. Estrus and Sexual Receptivity: estrus behavior is the display of sexual receptivity by females, often characterized by specific signs and behaviors that signal their readiness to mate. For example, in dairy cattle and swine, signs of estrus include restlessness, swollen vulva, reddish vulva, clear mucus discharge, frequent urination, and mounting of other animals within the flock

(Reith and Hoy, 2018).

ii. **Mating Behavior**: mating behavior refers to the courtship and copulatory activities that lead to sexual reproduction. It involves various actions and displays by males and females to attract and engage potential mates. For example, in cattle, cows on heat may display mounting behavior when approached by a bull (Toledo et al., 2023). In poultry, cocks engage in vocalizations and dance-like displays to attract hens (Rauw et al., 1998).

iii. Parental Care: parental care behaviors encompass the actions taken by parents, typically females, to provide for the well-being and protection of their offspring. These behaviors are crucial for the survival and development of young animals. For example, sows exhibit nesting behavior before farrowing to provide a safe and comfortable environment for piglets (Haskell and Hutson, 1996). Does (female rabbit) also pull off their hair to make bedding for the expected kids. Broody hens incubate and care for their eggs and chicks (Stutchberry,1998).

iv. Parturition Behavior: parturition behavior is the set of actions and behaviors exhibited by pregnant females during labor and the birthing process. For example, ewes may exhibit restlessness, pawing at the ground, and vocalizations as signs of impending labor (Lauber and Fricke, 2023). Cows may isolate themselves from the herd and seek out a quiet place for calving (Krasnec et al., 2012).

7. Agonistic behaviors: agonistic behaviors are a set of behaviors exhibited by animals during conflicts or contests over resources, such as food, territory, or mates. These behaviors can range from subtle displays of dominance to overt acts of aggression. Agonistic behavior is another type of social interaction among animals, particularly involved in the definition of populations' hierarchical structures, with some individuals displaying a dominant, active, and more aggressive behavior, while others act more submissive and less active (Young, 2019). Sound knowledge of agonistic behaviors is crucial for gaining insight into the social dynamics and evolutionary strategies of animal species. Agonistic behaviors may be intra-specific (within the same species) or inter-specific (among different species)

Types of Agonistic Behaviors:

Threat Displays: these are behaviors that animals use to intimidate rivals without physical contact. For example, strutting, fighting advance, and retreating among cocks are meant to chase away rivals (Wood-Gush, 1956).

Attack Behaviors: these are aggressive behaviors aimed at causing harm or asserting dominance. Examples include biting, kicking, or ramming (Drews, 1983) and other form of inter-male or inter-female fighting (Figure 4)

Figure 4: Animal fighting

Submission Behaviors: these behaviors are displayed by subordinate animals to appease dominant individuals and avoid conflict. Examples include crouching, avoiding eye contact, or presenting the ventral side of the body (McGlone, 1986).

Territorial Behaviors: these behaviors are aimed at defending a specific area or resource (Craig and Guhl, 1969). Examples include marking territory with scent or vocalizations and chasing away intruders (Figure 5).

Figure 5: Animal chasing an intruder

These behaviors are very useful to assess the emotional state of the animals and their general well-being.

Furthermore, the rights of the animals must be protected and well respected. Key issues within the animal rights movement include advocating for the abolition of practices such as factory farming, animal testing, the use of animals in entertainment, and illegal hunting of animals in the wild. (Ajayi and Alabi, 2024).

Above all, the concept of animal rights represents a growing recognition of the moral status of animals and a call for greater compassion and respect towards them in human society (Adewoye, 2022).

Mr. Vice-Chancellor sir, the above-mentioned areas of animal welfare, behavior, and rights are crucial to livestock production most especially as they may affect the general well-being of the animals. These stimulated my interest in animal welfare. The focus of my research thrust is how humans and animals will live well knowing fully well that mankind's love for animals ends at the dining table, nevertheless, the animals must live and later die well.

4.0 . My contributions to knowledge ("That all may live well")

Mr Vice-Chancellor sir, my contributions to knowledge will be chronicled under the following areas of animal physiology as related to animal welfare; (i) Environmental physiology (ii) Nutritional physiology (iii) Reproductive physiology (iv) animal health (v) animal and human relationship.

4.1 Environmental physiology

Knowledge about the environment and how it affects the animal's performance and their well-being is very important. The performance of animals is an outcome of the interactions between the genetic make-up of that animal and its immediate environment.

P= G+E (where P= performance; G= genetic make-up; E= environment)

Components of an animal's environment include not only the climatic conditions but also other parameters such as housing, stocking density, and general husbandry. Animals must be kept in houses conducive to their general well-being for optimal performance taking into consideration the **five freedoms (5Fs).** These freedoms according to FAWC (1979) are:

- Freedom from hunger and thirst
- Freedom from discomfort
- Freedom from pain, injury, or disease
- Freedom to express normal behavior
- Freedom from fear and distress

The housing environment plays a crucial role in determining the welfare of animals in various production systems. Adequate housing provides animals with protection from adverse weather conditions, predators, and stressors, allowing them to express natural behaviors and maintain good health. Adequate space allowance is essential for minimizing stress, and promoting their physical and psychological well-being. Environmental enrichment is essential for promoting natural behaviors and reducing stress in housed animals (Appleby, 1998). Enrichment elements such as perches, nesting materials, and toys can enhance the welfare of animals by providing them with opportunities for exploration, play, and social interaction. Enriched environments are particularly important for species with complex behavioral needs, such as pigs, poultry, and laboratory animals (Appleby et al., 1993). The housing environment influences the behavior and physiology of animals. Positive housing conditions can lead to reduced stress, improved social dynamics, and better overall welfare. Conversely, poor housing can result in abnormal behaviors, such as stereotypes and aggression, as well as increased susceptibility to diseases and injuries.

The use of conventional battery cages for housing chickens has been banned in developed countries such as the United Kingdom, USA, Europe, Canada, and Australia where chickens are raised on free-range in line with good welfare (Abrahamsson and Tauson, 1995). However, this is not so in developing countries where the use of conventional battery cages is still in vogue (Alabi et al., 2013).

In line with poultry housing, I conducted some research on different intensive housing systems and their effects on the performance of egg-type chickens.

Alabi et al. (2006) and Alabi et al.(2016), reported that the housing system has significant effects ($p<0.05$) on feed intake, final body weight, hen-day production, mortality rate, and egg weight, but not on the initial body weight and egg quality (Table 1 and 2). In these works, deep litter system, conventional battery cage system, and extended battery cage system were used. We reported that deep litter system is the best way of housing chickens for now from a welfare point of view, particularly in situations where farmers are constrained to practice a free-range system.

Table 1: Performance characteristics of hen in different housing systems

	Treatment			
Parameters	PBC	EBC	DLS	SEM
Av. Daily feed intake (g/bird/day)	111.61^{c}	120.74^{b}	130.25^{n}	0.45
Av. Initial body weight (kg)	1.48	1.50	1.50	1.005
Av. Final body weight (kg)	1.78^{a}	1.76^{a}	1.69^{b}	0.15
Av. Body weight change (kg)	0.30^{a}	0.26^{b}	0.19^{c}	0.03
Av. Hen daily lay (%)	75.01^{a}	74.49^{a}	71.52^{b}	0.40
Feed conversion ratio	2.05^{c}	2.10^{b}	2.37^{a}	0.11
Cost of feed/dozen eggs (N)	68.50	68.75	74.75	
Mortality (%)	5.55	5.55	11.11	

... means along the same row with the same superscript are not significantly different ($p>0.05$)
PBC= partitioned battery cage (conventional); EBC= extended battery cage; DLS= deep litter system
(Source: Alabi et al., 2006)

Table 2: Egg quality characteristics of hens in different intensive housing systems

Parameters	PBC	EBC	DLS	SEM
Egg weight (g)	63.13[a]	62.85[a]	60.07[b]	0.10
Shell thickness (mm)	0.38	0.39	0.38	1.01
Albumen weight (% egg weight)	63.93	63.71	63.53	0.54
Yolk weight (% egg weight)	23.73	23.58	23.44	0.60
Haugh Unit (%)	74.30	74.12	73.98	0.10
Yolk length (cm)	4.12	4.12	4.11	0.05
Yolk diameter (cm)	1.57	1.57	1.58	0.02
Yolk index	0.38	0.38	0.38	

Means along the same row with the same superscript are not significantly different (p>0.05)
PBC= partitioned battery cage (conventional); EBC= extended battery cage; DLS= deep litter system
(Source: Alabi et al., 2006)

Upon further investigations, Alabi et al.(2011c), Alabi et al.(2014a), Alabi et al.(2014b), Alabi et al.(2015), and Alabi et al. (2018) reported the effect of these housing systems on blood profile of two strains of egg-type chickens. The blood parameters such as the packed cell volume, hemoglobin concentration, white blood cell counts, and red blood cell counts were not negatively affected by the housing systems. Their values were within the normal range expected for the chickens (Table 3). Also, investigations on stress indicators of egg-type chickens on different housing systems in humid tropics revealed that the differential white blood cell concentrations for the heterophils and lymphocytes were affected significantly. Chickens housed in conventional battery cages had the highest value of heterophils and the lowest value of lymphocytes thereby having the highest heterophil/lymphocyte ratio (Table 4). We affirmed that chickens housed in conventional battery cages were stressed significantly more than those in deep litter. Also, we reported that egg-type chickens housed in conventional battery cages recorded the highest level of blood cortisol to further confirm that they were stressed by the housing system (Table 5). All these were indications of bad welfare! (Alabi, 2011).

Table 3: Effect of different intensive housing systems on hematological parameters of egg-type chickens

Treatments					
Parameters	Strain	PCC	ECC	DLS	Normal value (*)
PCV (%)	SBL	31.45 ± 1.50	31.55 ± 1.50	31.55 ± 1.50	24.90 – 40. 70
	SBR	31.44 ± 1.50	31.50 ± 1.50	31.48 ± 1.60	
Hb (g/dl)	SBL	9.48 ± 0.06	9.45 ± 0.06	9.46 ± 0.05	7.40 – 12.20
	SBR	9.49 ± 0.06	9.46 ± 0.05	9.45 ± 0.06	
WBC (10^3/ul)	SBL	3.05 ± 0.05	3.09 ± 0.06	3.06 ± 0.06	3.03 – 21.20
	SBR	3.08 ± 0.06	3.08 ± 0.06	3.08 ± 0.06	
RBC (10^6/ul)	SBL	2.90± 0.06	2.92 ± 0.06	2.85 ± 0.05	1.50 – 3.82
	SBR	2.83± 0.06	2.88 ± 0.05	2.82 ± 0.05	
MCV (fl)	SBL	120.15 ± 5.00	120.00 ± 5.00	120.05 ± 5.00	102 – 129
	SBR	119.85 ± 5.00	120.55 ± 5.00	120.05 ± 5.00	
MCH (pg)	SBL	39.30 ± 2.05	38.51 ± 2.00	39.30 ± 2.00	31.90 – 40.70
	SBR	38.95 ± 2.00	39.00 ± 2.00	38.00 ± 2.00	
MCHC (%)	SBL	30.98 ± 2.05	30.85 ± 2.05	30.95 ± 2.00	25.90 – 33.90
	SBR	31.50 ± 2.05	30.65 ± 2.05	31.05 ± 2.00	

PCC = Partitioned Conventional Cage, ECC = Extended Conventional Cage, DLS= Deep Litter *System, SBR = Super Black Strain, SBR = Super Brown Strain, * Normal Values = Reference Values (in range) for female chickens (Mitruka and Rawnsley, 1977)*

(Source: Alabi et al., 2015)

Table 4: Effect of different intensive housing systems on white blood cell counts, differential leukocyte counts, and H/L ratios of egg-type chickens

Parameters	Treatments				
	Strains	PBC	EBC	DLS	Normal Value (*)
WBC (10^3/ul)	SBL	3.05±0.01	3.09±0.008	3.04±0.01	3.03-21.20
	SBR	3.08±0.01	3.08±0.009	3.11±0.01	
Heterophils (%)	SBL	33.02±0.96^a	28.10±0.89^b	25.80±0.85^c	15.20-32.80
	SBR	33.05±0.96^a	28.00±0.88^b	25.50±0.84^c	
Lymphocytes (%)	SBL	60.05±3.05^c	65.00±3.35^b	68.20±3.55^a	47.20-81.20
	SBR	60.00±3.03^c	65.90±3.38^b	68.00±3.46^a	
Monocytes (%)	SBL	3.42±0.06^a	3.19±0.03^c	3.28±0.05^b	0.06-0.78
	SBR	3.43±0.06^a	3.20±0.03^c	3.27±0.05^b	
Eosinophils (%)	SBL	1.50±0.03^a	1.31±0.02^b	1.20±0.02^c	6.25-8.25
	SBR	1.50±0.03^a	1.30±0.02^b	1.21±0.01^c	
Basophils (%)	SBL	2.01±0.03^a	1.60±0.02^b	1.52±0.008^c	2.50-5.30
	SBR	2.02±0.03^a	1.60±0.02^b	1.52±0.008^c	
H/L ratio	SBL	0.55±0.008^a	0.43±0.005^b	0.37±0.003^c	
	SBR	0.55±0.008^a	0.42±0.005^b	0.37±0.003^c	

abc = means with different manuscripts along the row are significantly ($P < 0.05$) different.

Means with no superscript indicate no significant ($P < 0.05$) difference.

PBC = Partitioned Battery Cage; EBC = Extended Battery Cage; DLS = Deep litter System; SBR = Super Black Strain; SBR = Super Brown Strain. * Normal values = Reference Values (in range) for female chickens (Mistruka & Rawnsley, 1977).

***(Source: Alabi et al., 2014*a)**

Also, egg-type chickens housed in conventional battery cages were more aggressive and manifested agonistic behavior than those in other alternative housing systems as reported by Alabi et al., (2020). Furthermore, the emission of gases was reported by Alabi and Akinoso (2016) to be higher in poultry houses with cages than in deep litter and free-range systems. Moreover, poultry houses must be well constructed to ensure good ventilation and must be rodent proof as Alabi et al.(2016) reported the prevention of rodents is essential in animal welfare and poultry production to prevent transmission of diseases, and to avoid feed wastage and feed contamination.

Table 5: Effect of different intensive housing systems on the serum metabolites of egg-type chickens

Treatments					
Parameters	Strain	PCC	ECC	DLS	Normal value (*)
TP (g/dl)	SBL	5.78 ± 0.05	5.72 ± 0.05	5.73 ± 0.05	5.20 – 6.90
	SBR	5.75 ± 0.05	5.77 ± 0.05	5.77± 0.05	
Albumin (g/dl)	SBL	4.56 ± 0.05	4.49± 0.05	4.50 ± 0.05	2.10 – 3.45
	SBR	4.55 ± 0.05	5.51± 0.05	4.52 ± 0.06	
Globulin (g/dl)	SBL	1.22 ± 0.02	1.18 ± 0.02	1.21 ± 0.02	1.90 – 2.30
	SBR	1.20 ± 0.02	1.19 ± 0.02	1.21 ± 0.02	
Uric Acid (mg/dl)	SBL	2.54 ± 0.04	2.57 ± 0.05	2.58 ± 0.05	2.47 – 8.08
	SBR	2.57 ± 0.04	2.59 ± 0.05	2.60 ± 0.05	
Cholesterol (mg/dl)	SBL	134.05 ± 6.00	135.00 ± 6.00	136.05 ± 6.00	52.00 – 148.00
	SBR	133.95 ± 6.00	134.55 ± 6.00	134.05 ± 5.50	
AST (mg/dl)	SBL	178.05 ± 6.50	179.00 ± 6.00	178.55 ± 6.00	88.00 – 208.00
	SBR	179.25 ± 6.00	180.05 ± 6.50	179.65 ± 6.50	
ALP (iu/l)	SBL	30.80 ± 2.05	29.85 ± 2.05	30.00 ± 2.00	24.50 – 44.40
	SBR	30.00 ± 2.05	30.05 ± 2.05	30.90 ± 2.00	
ACP (IU/L)	SBL	35.00 ± 2.50	35.45 ± 2.50	36.00 ± 2.55	23.00 – 41.60
	SBR	35.85 ± 2.50	36.00 ± 2.55	335.85 ± 2.50	
Creatinine (mg/dl)	SBL	1.25 ± 0.02	1.23 ± 0.02	1.22 ± 0.02	0.90 – 1.85
	SBR	1.24 ± 0.02	1.22 ± 0.02	1.20 ± 0.02	
Serum Cortisol (mg/ml)	SBL	20.05 ± 2.00[a]	19.00 ± 2.00[a]	16.50 ± 1.85	12.05 – 18.00
	SBR	20.55 ± 2.00	19.55 ± 2.00[a]	16.00 ± 1.85[b]	

*PCC = Partitioned Conventional Cage, ECC = Extended Conventional Cage, DLS= Deep Litter System, SBR = Super Black Strain, SBR = Super Brown Strain, * Normal Values = Reference Values (in range) for female chickens (Mitruka and Rawnsley, 1977)*

(Source: Alabi et al.,2015)

The performance of animals greatly depends on the prevailing climatic conditions and seasonal changes as well as the qualities of the products obtainable. In a collaborative research, Oguntunji et al.(2008a), investigated the effect of season on the performance of a commercial laying stock with emphasis on their egg production pattern, mortality rate, and incidence of cracked eggs in early rain season (ERS); April-June, late rain season (LRS); July- September, early dry season (EDS); October- December and late dry season (LDS); January to March. We reported that the effect was much more pronounced on the laying chickens negatively in LDS with higher ambient temperatures and lower relative humidity. Egg production per day decreased significantly in LDS (Table 6).

Table 6: Effect of seasonal variation on egg production of a commercial laying stock

Seasons							
Wet				Dry			
Month	Av. Flock No	Av Egg/day	% egg/day	Month	Av. Flock No	Av egg/day	% Egg/day
April	5066.67	3811.66	75.23	Oct.	4281.01	3356.31	78.40
May	4447.15	3218.11	73.77	Nov.	4239.50	3136.81	73.99
June	4407.00	3378.85	76.67	Dec.	4189.55	3029.04	72.30
			*75.22				*74.90
July	4385.01	4030.26	91.91	Jan.	4138.22	2805.36	69.79
August	4361.33	3362.59	77.10	Feb.	1629.29	761.55	46.74
Sept.	4306.87	3326.20	77.23	Mar.	855.17	352.50	41.22
			*82.08				*52.58
Mean ± SE			78.65 ± 6.01^a	Mean± SE			$63.74+14.29^b$

(Source: Oguntunji et al., 2008a)

In a survey carried out on a commercial farm in a derived savanna environment of Nigeria, Oguntunji et al. (2008b) further established that seasonal variations affect not only the daily egg production but also the feed intake, mortality rate, and egg qualities negatively most especially in the dry season. Consequently, Oguntunji and Alabi (2010) put the record straight that despite the large amount of money invested in research, breeding, and the improvement of commercial egg-type strains of chickens, high environmental temperature (HET) has been identified as a major non-genetic constraint limiting expression of their full genetic potential.

Apart from the direct influence on animals, the qualities of products obtained from them can also be affected by the storage condition. Ayoola et al.(2016) reported that the internal qualities of eggs are influenced by temperature and length of storage. The egg quality parameters declined as the temperature increased over days. We concluded that table eggs should not be stored for more than 21 days under room conditions to prevent nutritional and economic loss (Figures 5 and 6).

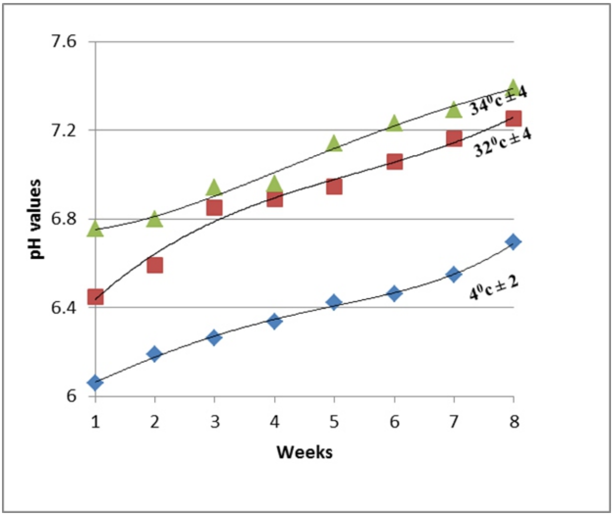


Figure 5: Effect of storage temperature and duration on Yolk pH
(Source: Ayoola et al., 2016)

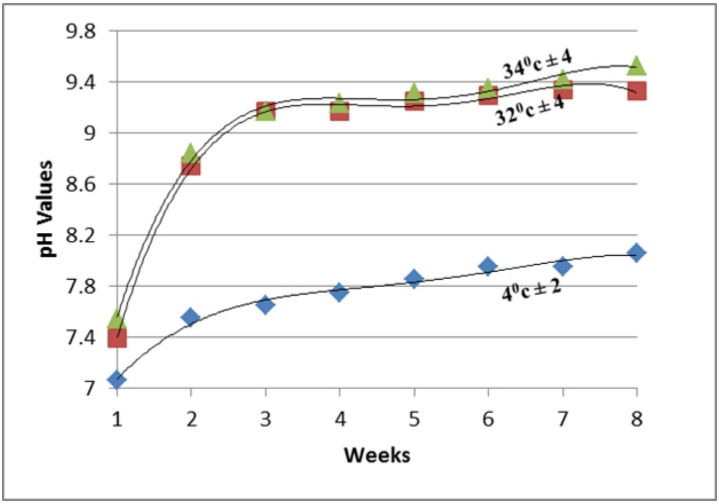


Figure 6: Effect of storage temperature and duration on albumen pH ***(Source: Ayoola et al., 2016)***

4.2 Nutritional physiology

Nutrition is the process through which nutrients are made available for living organisms. Nutrition plays a critical role in determining the overall health, behavior, and welfare of animals in various production systems. Adequate nutrition is essential for meeting the physiological and behavioral needs of animals, while nutritional deficiencies or imbalances can lead to a range of welfare issues. Nutrients must be well balanced to meet the requirements of animals to get the maximum level of output from such.

Mr. Vice-Chancellor sir, there is a popular Yoruba adage that says"*ki agbada to daye, nkan kan ni adie nje",* meaning *" before the discovery of maize, chickens were eating something*". Yes, those things that chickens were eating before the discovery of maize have put animal nutritionists on their toes for many decades now looking for what can be used to replace maize and other important but expensive ingredients in the diets of chickens.

My profound interest in nutritional physiology made me realize that many farmers are just packing all sorts of materials for their chickens to eat to maximize profit and minimize cost not minding possible negative implications of these feed ingredients on their chickens, physiologically.

Agro-industrial by-products (AIBs), crop residues, plant extracts, and leaf meals have been researched and severally reported as alternative feed ingredients for chickens with little care to find out the likely side effects of their incorporation on chicken body system physiologically hence my voyage in nutritional physiology. Meanwhile, values of blood indices are good indicators of the physiological responses of animals to feed toxicity. Hematological parameters such as red blood cell count, hemoglobin concentration, and packed cell volume suggest adequate erythropoiesis and oxygen transport which are essential for tissue oxygenation and overall metabolic functions. The trend of white blood cell count and differential leukocytes will give a clear picture of the immune function and defense against pathogens. The serum metabolites are pointers to the state of liver and kidney functions of the animal as well as the degree of tissues worn out as a result of a particular treatment.

Alabi and Okediji (2009), investigated the possibility of using Cowpea Testa Meal (CTM), a common kitchen waste, to replace groundnut cake (GNC) in the diet of cockerels and found that replacing 25% of GNC with CTM in the diets of cockerel starters improved the feed intake and live body weight gain.

Also, in another experiment, Alabi et al. (2011a) reported that CTM can replace GNC with up to a 50% inclusion rate without any adverse effect on the growing cockerels physiologically (Table 7).

Table 7: Serum metabolites of cockerel starters fed with graded levels of CTM

Parameters	Treatments					
	T1	T2	T3	T4	T5	SEM
Total Protein (TP)(g/dl)	3.62	3.55	3.50	3.48	3.52	0.20
Albumin (g/dl)	1.96[a]	1.75[ab]	1.69[ab]	1.40[b]	1.39[b]	0.10
Globulin (g/dl)	1. 66[c]	1.89[b]	1.90[b]	2.18[a]	2.13[a]	0.20
Alb/Glb ratio	1.28	0.97	0.94	0.71	0.65	
Blood Urea Nitrogen (BUN; mg/dl)	24.30[a]	20.15[b]	20.20[b]	18.42[c]	18.38[c]	0.80
Creatinine (mg/dl)	1.42[c]	1.45[c]	1.71[b]	1.99[a]	2.15[a]	0.10
Bilirubin (mg/dl)	0.35[b]	0.38[b]	0.57[a]	0.60[a]	0.61[a]	0.05
AST (iu/l)	8.50	8.65	8.60	8.62	0.20	8.65
ALT (iu/l)	4.26[c]	4.30[b]	4.32[b]	5.21[a]	5.23[a]	0.03
ALP (iu/l)	31.48[c]	36.82[b]	47.45[a]	49.50[a]	50.05[a]	1.50

T1-T5: Treatments 1 to 5; SEM: Standard Error of Means; abc: Means with different superscript are significantly different (p<0.05)

(Source: Alabi et al.,2011a)

In another experiment, Alabi and Ayoola (2010), reported that indomie noodle waste meal can be used to replace maize in the diets of broilers. In this research, maize in broilers diet was replaced at graded levels of 0% (control), 25%, 50%, 75% and 100%. We concluded that birds on 50% replacement level gave the best feed conversion ratio and feed conversion efficiency. Alabi et al.(2011b), Alabi et al.(2011c), and Alabi et al. (2012a) later reported that the replacement did not affect the blood parameters of the chickens negatively (Tables 8 and 9).

In other collaborative works, we investigated the use of plant extracts as an additive to chicken feeds. Fluted pumpkin (*Telfaria occidentalis*) is known to be rich in minerals (Ayoola et al.,2010; Ladokun et al., 2013) and we therefore exploited its usefulness in poultry nutrition. Alabi et al.
(2008); Alabi et al.,(2009); Alabi et al. (2017) reported that *Telfaria occidentalis* leaf extract will improve the growth rate of broiler chickens and also improve the carcass yield and the packed cell

volume of the blood at the finisher phase with no adverse effect on the chickens (Table 10).

Table 8: Effect of Replacing Maize with Indomie Noodle Waste Meal in the Diets of Broiler Finishers on the Hematological Parameters

Treatments						
Parameters	1	2	3	4	5	SEM
Hb (g/dl)	9.20[a]	8.50[a]	9.20[a]	8.80[a]	7.50[b]	0.70
Packed Cell Volume (%)	29.00[a]	27.00[a]	29.00	28.00	25.00[b]	2.50
White Blood Cells (103/µl)	2.00	2.10	2.10	1.90	2.00	0.30
Red Blood Cells (106/µl)	2.65	2.67	2.65	2.68	2.65	0.20
MCH (Pg)	3.47[a]	3.18[a]	3.47[a]	3.28[a]	2.83[b]	0.30
Mean Cell Volume (fl)	10.49[a]	10.11[a]	10.94[b]	10.44[a]	9.05[b]	0.85
MCHC (%)	31.00	31.00	32.00	31.00	31.00	2.00

abcd: means with different superscripts are significantly different ($p < 0.05$)
SEM: Standard Error of Mean; MCH= Mean corpuscular hemoglobin; MCHC= Mean corpuscular hemoglobin concentration

(Source: Alabi et al.,2012)

In other collaborative research, Aderemi and Alabi (2013), investigated responses of broiler chickens fed graded levels of cassava peel meal (CPM) fortified with *Morringa* leaf meal. We reported that apart from the fact that the feed intake and weight gain were significantly ($p<0.05$) affected positively, the PCV, Hb concentration, and total protein of the blood were also influenced positively. Also, Aderemi et al.(2018) investigated the replacement of fish meal (FM) with duckweed meal (DWM) at graded levels in broiler diets and we reported that DWM can replace FM at a 25 % substitution level without adverse effect on chicken growth rate and blood profile both at starter and finisher phases.

Along the same line, some spices were reported to have probiotic activities in monogastric nutrition and this prompted us to investigate their tolerable level of inclusion. In an experiment conducted on old layers where pepper (*Capsicum annum*) and garlic (*Allium sativa*) were included as feed additives at the graded level, Aderemi et al., (2013) reported that the egg production pattern of the chickens improved, and also the yolk length, albumen height and Haugh unit of the egg. The inclusion of pepper/garlic in the diet of old layers will improve their hen day production and egg qualities without any adverse effect on the birds.
Aderemi et al.,(2017) investigated the effect of replacing soybean meal with fermented locust bean meal (*Parkia biglobosa*) in the diets of broiler chickens at both starter and finisher phases and we reported that the production performance, blood profile, and gut morphology of the chickens were not affected negatively. Also, in a research conducted with Afolabi et al.,(2017), we found out that hot red pepper (*Capsicum annum L.)* meal enhanced the immunity and performance of broilers with reduced cost of production (Table 11).

Table 9: Effect of replacing maize with indomie noodle waste meal on the relative internal organ weight of broiler finishers

	Treatments					
Parameters	1	2	3	4	5	SEM
Liveweight(kg)	2.18^c	2.36^b	2.30^b	2.00^d	2.49^a	0.08
Gizzard(%)	2.83^a	2.38^b	1.78^c	1.59^e	1.69^d	0.08
Proventriculus(%)	0.53^a	0.54^a	0.35^c	0.47^b	0.47^b	0.02
Spleen(%)	0.10^c	0.12^b	0.13^b	0.16^a	0.09^c	0.02
Heart(%)	0.51^b	0.40^c	0.44^c	0.72^a	0.38^c	0.07
Liver(%)	1.96^b	1.62^d	1.82^c	3.95^a	1.91^b	0.07
Abdominal fat(%)	1.70^b	3.17^a	1.84^b	0.61^c	3.05^a	0.15

abcde: Means with different superscript are significantly different ($p<0.05$).
SEM: Standard Error of Means

(Source: Alabi and Ayoola, 2010)

Table 10: Effect of *Telfaria occidentalis* leaf extract on hematological parameters and serum metabolites of broiler chickens at the finisher phase

Treatments	T_1	T_2	T_3	T_4	SEM
Haematological parameters					
Packed cell volume (PCV) (%)	30.9^c	32.4^b	32.6^b	33.41^a	0.8
Heamoglobin (Hb) ($g{*}dL^{-1}$)	9.1^c	9.2^b	10.3^b	10.8^a	0.4
Red blood cell (RBC) ($10^6{*}\mu L^{-1}$)	3.35^d	3.45^c	3.52^b	3.58^a	0.05
White blood cell (WBC) ($10^6{*}\mu L^{-1}$)	1,180	1,180.5	1,190	1,181	11
Mean cell volume (MCV) (fL)	92.23	94.2	92.61	93.32	2
Mean corpuscular haemoglobin (MCH) (pg)	27.16^b	27.67^b	29.26^a	30.16^a	1
Mean corpuscular haemoglobin (MCHC) concentration (%)	2.94^b	2.83^b	3.16^a	3.23^a	0.15
Serum biochemistry parameters					
Glucose ($mg{*}dL^{-1}$)	133.65^c	135.55^b	137.75^a	138.3^a	1.5
Calcium ($mg{*}dL^{-1}$)	14.5^b	14.9^b	15.5^a	15.6^a	0.5
Globulin ($g{*}dL^{-1}$)	2.7	2.75	2.75	2.7	0.6
Albumin ($g{*}dL^{-1}$)	2.80^d	2.9^c	3.1^b	3.55^a	0.08
Total protein ($g{*}dL^{-1}$)	5.50^c	5.65^b	5.85^b	6.25^a	0.51
Cholesterol ($mg{*}dL^{-1}$)	49.03^c	51^b	54.6^{ab}	55.25^a	1
Uric acid ($mg{*}dL^{-1}$)	2.04	2	1.98	2.01	0.05
Creatinine ($mg{*}dL^{-1}$)	2.2	2.21	2.21	2.2	0.05

[abcd]Means along the same row with different superscripts are significantly (P<0.05) different using Duncan's test as post hoc analysis.

(Source: Alabi et al.,2017

Table 11: Effect of dried hot pepper meal on blood parameters of broiler chickens

Treatments	1	2	3	4	SEM
Levels of DHRP meal	0	0.1	0.2	0.3	
Packed cell volume (ml%)	62.28	58.16	59.88	57.57	4.37
Platelets (x 10^3/mm^3)	51.67^{ab}	27.00^{b}	39.33^{b}	73.33^{a}	8.62
Haemoglobin (g/dl)	10.43	10.40	9.03	9.90	1.69
Leucocytes (x 10^3/mm^3)	4.7^{b}	5.63^{b}	11.27^{a}	13.73^{a}	0.87
MCHC (%)	16.78	18.24	15.09	16.87	2.69

$^{a-b}$Means with different superscript across rows are significantly ($p<0.05$) different

DHRP = Dried hot red pepper (*Capsicum annum*); SEM = Standard error of mean; MCHC = Mean corpuscular haemoglobin concentration.

(Source: Afolabi et al., 2017)

Mr. Vice-Chancellor sir, in some other collaborative research along using agro-industrial by-products biodegraded with enzymes, we investigated how well meat and egg-type chickens can perform on some test ingredients without being harmed physiologically. Aderemi et al. (2006) reported that laying birds fed a cassava root sievate-based diet supplemented with antizyme and dried pure yeast produced more eggs significantly than those fed with a conventional diet without a negative effect on their internal organ weights (Table 12).

Aderemi et al. (2014), investigated the replacement value of spent mushroom substrate(SMS) over wheat bran in the diet of broiler chickens at both starter and finisher phases and the results revealed that SMS can replace wheat bran up to 50% substitution rate with improved live weight gain, nutrient digestibility without adverse effect on blood hematology and serum metabolites.

Table 12: Relative organ morphology of broiler finisher fed undegraded and degraded cassava root sievate

Parameters (%)	Control	C S + A n	CS+T v	CS+R s	CS+M m	C S + CE	S E M
Crop	0.98[a]	0.88[b]	0.89[b]	0.90[b]	0.89[b]	0.90[b]	0.01
Proventriculus	1.88	1.79	1.80	1.81	1.77	1.85	0.05
Gizzard	3.95[a]	3.90[b]	3.94[a]	3.91[b]	3.95[a]	3.90[b]	0.41
Small intestine wt	4.41	4.01	4.33	4.71	4.84	4.50	0.21
Large intestine wt	3.35	3.24	3.32	3.19	3.20	3.23	0.11
Caecum	0.55	0.65	0.60	0.63	0.58	0.60	0.24
Heart	0.57	0.56	0.54	0.56	0.55	0.56	0.03
Liver	2.93	3.11	2.80	3.01	2.85	2.95	0.27
Spleen	0.19	0.18	0.18	0.18	0.17	0.17	0.05
Abdominal fat	2.60	2.40	2.31	2.52	2.45	2.57	0.07

(Source: Aderemi et al., 2006)

Alabi et al. (2021) investigated the antilipemic effect of moringa leaf powder on the serum cholesterol concentration of broiler chickens at the finisher phase. MLP was used as an additive at graded levels of 0g, 40g, 80g, and 120g per 100kg of feed. We reported that total cholesterol and the bad fractions got reduced as the inclusion rate increased thereby confirming that moringa leaf powder has an antilipemic effect (Table 14).

Table 14: Effect of moringa leaf powder on serum cholesterol fractions of broiler chickens at finisher phase

Parameter (mg/dl)	Treatments				
	T1	T2	T3	T4	SEM
Total Cholesterol	153.53[a]	148.65[a]	125.42[b]	120.05[b]	8.00
Triglycerides	143.63[a]	142.15[a]	130.05[b]	128.65[b]	7.50
Low density lipoprotein	72.51[a]	70.38[a]	58.50[b]	49.50[c]	5.50
High density lipoprotein	38.75[b]	40.42[b]	67.50[a]	68.40[a]	5.00
Very low density lipoprotein	90.55[a]	90.00[a]	86.40[b]	70.45[c]	6.50

abcd: Means with different superscript are significantly different ($p<0.05$).SEM: Standard Error of Mean.

(Source: Alabi et al., 2021)

Also, Lawal et al.(2007a&b), investigated the possibility of increasing nutrient availability in cassava root sievate (CRS) through bio-degradation with enzymes obtained from four common fungi; *Aspergillus niger, Trichoderma viride, Rhizopus stolonifer and Mucour mucedo*. Biodegraded CRS was fed to broiler chickens at different inclusion rates and the results revealed that birds on biodegraded CRS had the highest final body weight and dry matter digestibility significantly than those on un-biodegraded CRS without a negative effect on the relative weights of some internal organs. We concluded that degradation of CRS with purified extracted enzymes enhances better performance and internal organ morphology of broiler chickens. In another experiment, Lawal, et al. (2012a) investigated changes in the *in-vitro* digestibility of wheat offal after bio-degradation with *Aspergillus niger* and the subsequent effect of performance of broiler chickens at starter and finisher phases. The results revealed that the crude protein contents and caloric availability increased with bio-degradation while broilers fed degraded wheat offal performed better significantly than the control group. Some other agro-industrial by-products such as citrus pulp, and plantain peel were also biodegraded, and effects on layers and broiler chickens were reported respectively (Lawal et al.,2012b; Lawal et al.,2012c). Moreover, Lawal et al.(2021)

reported that broiler chickens fed brewer's dried grain (BDG) degraded by *Fusarium oxysporum* had better live weight gain and nutrient utilization significantly than those fed undegraded BDG.

Furthermore, Aderemi and Alabi (2023) reported that tumeric (*Curcuma longa*) when incorporated into the feed of chickens, can serve as an alternative to antibiotics in poultry nutrition, thereby improving their health condition.

4.3 Reproductive physiology

Reproductive physiology plays a crucial role in the success of animal production systems. It encompasses various processes and functions related to the reproductive system, including hormonal regulation, gamete production, mating behavior, and pregnancy maintenance. Reproductive physiology directly influences fertility and reproductive efficiency in animals. Fertility is a key determinant of the reproductive performance of animals and is influenced by various factors, including genetics, nutrition, health, and management practices.

Advances in reproductive technologies, such as artificial insemination (AI), embryo transfer (ET), and in vitro fertilization (IVF), have revolutionized animal breeding practices. These technologies rely on a deep understanding of reproductive physiology to manipulate reproductive processes and improve breeding outcomes.

Hormones play a central role in regulating reproductive processes in animals. Key hormones involved in reproduction include gonadotropin-releasing hormone (GnRH), follicle-stimulating hormone (FSH), luteinizing hormone (LH), estrogen, and progesterone. These hormones regulate the growth and development of reproductive organs, control the estrous cycle and ovulation, and maintain pregnancy.

Reproductive failure is a significant concern in farm animal production, as it can lead to economic losses, reduced productivity, and compromised animal welfare.

Hormonal imbalance can have a range of effects on reproduction in farm animals, including reduced fertility, irregular estrous cycles, and increased incidence of reproductive disorders. For example, cows with low progesterone levels may experience irregular estrous cycles and reduced fertility, leading to longer calving intervals and lower reproductive efficiency (Nascimento et al., 2019). In pigs, stress-induced hormonal imbalance and nutritional deficiencies can lead to reduced sperm quality and lower conception rates among sows (Cooke et al., 2018).

To ameliorate the problem of hormonal imbalance among farm animals, exogenous administration of some steroidal hormones is inevitable. Under reproductive physiology and in collaboration with other researchers, I investigated how some synthetic and natural gonadal steroids can be used to improve the reproductive efficiency of some monogastric animals.

Ladokun et al. (2012) investigated the effect of exogenous progesterone on testis characteristics of large white boars and we reported that seminiferous tubules diameter, paired testes weight, and daily sperm production increased significantly with hormonal treatment and concluded that exogenous progesterone can be used to maintain viability in boars (male pig) (Table 15).

Essien et al. (2008) investigated the growth response of cockerels to different durations of administration of testosterone propionate and reported that the growth of cockerels can be enhanced with hormonal treatment for early puberty attainment.

In a similar experiment, Alabi and Oguntunji (2011), reported that exogenous testosterone enanthate can enhance growth rate and puberty attainment among male chickens with no negative effect on the blood parameters of the animals (Table 16).

Table 15: Testis characteristics of boars injected with progesterone from birth to 24 weeks of age

Testicular Characteristics	**Control**	**Progesterone treated**
Seminiferous tubules diameter (μ)	117.73+ 11.26[b]	164.99 + 21.9[a]
Paired testes weight (g/kg)	101.46+221.83[b]	205.98 + 42.00[a]
PTW per kg body weight (g/kg)	3.27	3.83
Testes density	1.10	1.05
Volume % round spermatic nuclei	1.74 + 0.04[b]	3.21 + 0.41[a]
Daily sperm production (DSP-GSRx10^0)	4.37 +1.9[b]	8.98 + 1.12[a]
DSP from QTH (x 10^6)	18.12 + 3.4[b]	30.87 + 3.0[a]
DSP per unit tubule diameter (x 10^6)	28.12 + 3.4[b]	48.57 + 4.11[a]

abc: means in the same row with different superscripts differ significantly ($p<0.05$)

(Source: Ladokun et al., 2012)

Table 16: Effect of exogenous testosterone enanthate on serum metabolites of cockerels

	Testosterone Level					
Parameters	T1	T2	T3	T4	T5	SEM
Total Protein (g/dl)	5.75	5.74	5.73	5.74	5.80	0.10
Albumin (g/dl)	1.34	1.33	1.33	1.32	1.36	0.06
Globulin (g/dl)	4.83	4.82	4.82	4.80	4.84	0.06
Uric acid (mg/dl)	2.51	2.52	2.51	2.52	2.53	0.03
Cholesterol (mg/dl)	178.45	179.48	180.05	179.50	180.45	2.50
Calcium (mg/dl)	185.45	185.42	185.40	185.42	186.01	1.00
Glucose (mg/dl)	155.10	154.85	155.85	155.75	155.85	1.50
Aspartate Transaminase (AST) {i.u/l}	32.20	32.30	32.28	32.25	32.28	0.20
Alkaline Phosphatase {i.u/l}	36.54	36.52	36.49	36.52	36.50	0.08
Acid Phosphatase {i.u/l}	19.50	19.48	19.48	19.47	19.49	0.05

abcd : means with the same superscript are not significantly (p>0.05) different.
SEM: Standard Error of Means.

(Source: Alabi and Oguntunji, 2011)

With many campaigns against the use of synthetic anabolic agents (hormones) in livestock production, the possibility of using natural hormonal extracts was looked into. Alabi et al. (2019) conducted an experiment where testicular extract from buck (he-goat) was collected and administered to male chickens (cockerels) and their growth rate and testicular weights were compared with those given synthetic testosterone and the control group. The results showed that cockerels on crude buck testicular extract recorded faster growth rates and higher testicular weights than birds in other treatment groups and therefore can be used to replace the synthetic steroids in hormonal replacement therapy (HRT) in livestock production (Table 17 and Figure 6).

To investigate the effect of exogenous female gonadal steroids (estrogen and progesterone) on puberty attainment, performance characteristics, and egg qualities of two strains of egg-type chickens in humid tropics, Alabi (2020), conducted an experiment using exogenous estradiol benzoate (E2), progestin (P4) and combination of the two hormones (EP) on laying chickens. I collected data on age at puberty (50% egg production), age at peak production, and also the weight and internal qualities of eggs from each category of the treated chickens. I reported that birds given progestin attained puberty and peaked earlier than others (Table 18). Also, egg weight and shell thickness got improved with the administration of E2 and EP while the egg weight and internal egg qualities such as albumen weight, yolk weight, and Haugh unit did not change significantly (Table 19).

Table 17: Effect of administration of crude buck testicular extract on some performance characteristics of cockerels

	Treatments			
Parameters	1	2	3	SEM
Initial body weight (kg)	1.09^b	1.01^c	1.11^a	0.01
Final body weight (kg)	2.06^c	2.12^b	2.24^a	0.05
Total body weight gain (kg)	0.97^c	1.11^b	1.13^a	0.01
Daily feed intake/birds(g)	133.00^c	135.00^a	134.00^b	0.80
FCR	12.22^c	13.55^b	14.96^a	0.25
Feed efficiency	0.07	0.07	0.08	0.01
Mortality (%)	0.00	0.00	0.00	-

^{abc} means along the same row with different superscripts are significantly ($P < 0.05$) different using Duncan's test as post hoc analysis.

(Source: Alabi et al.,2019)

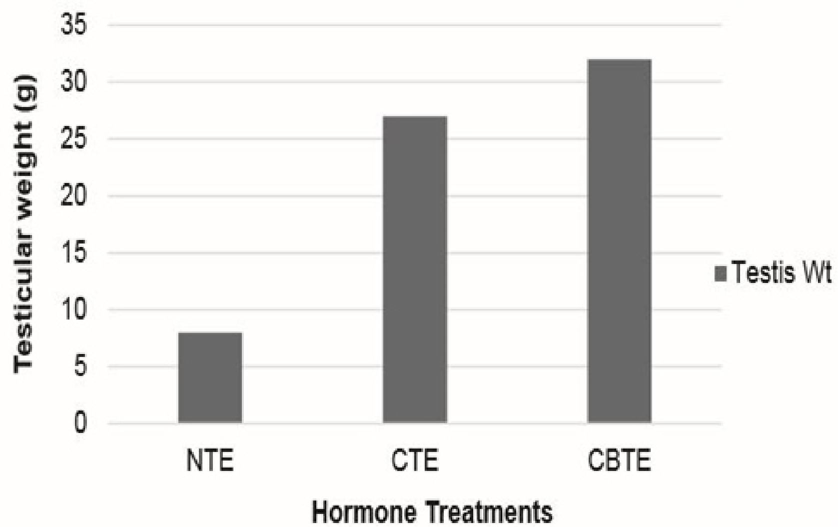


Figure 6: Effect of administration of crude buck testicular extract of testis weight of cockerels

(Source: Alabi et al., 2019)

Table 18: Effect of exogenous female gonadal hormones on puberty attainment of egg-type chickens

		Treatments				
Parameters	Strains	NH	E_2	P_4	EP	SEM
ADFI (g)	IBL	94.08^{cx}	96.15^{bx}	99.38^{ax}	96.45^{bx}	0.50
	IBR	90.75^{cy}	93.60^{by}	96.55^{ay}	93.75^{ay}	0.55
	SEM	0.70	0.68	0.65	0.71	
Age at puberty (days)	IBL	164.33^{ax}	157.67^{bx}	152.67^{cx}	157.33^{bx}	4.50
	IBR	160.33^{ay}	154.67^{by}	149.67^{cy}	153.67^{by}	4.30
	SEM	3.50	2.50	2.50	3.15	
Age at peak production (days)	IBL	189.67^{ax}	182.33^{bx}	177.67^{cx}	182.67^{bx}	4.50
	IBR	187.33^{ay}	178.33^{ay}	175.33^{by}	177.67^{ay}	4.20
	SEM	2.00	3.50	3.00	3.50	
Mortality rate (%)	IBL	0.00	5.55	8.33	5.55	
	IBR	2.78	5.55	8.33	5.55	

abc: means in the same row with different superscript are significantly different ($p < 0.05$)
xy: means in the same column with different superscript are significantly different ($p < 0.05$)
ADFI = Average Daily Feed Intake, NH = No Gonadal steroid, E_2 = Estradiol , P_4 = Progestin, EP = Estradiol + Progestin

(Source: Alabi, 2020)

Table 19: Effect of exogenous gonadal hormones on weight and internal qualities of eggs from treated egg-type chickens

	Treatments				
Parameters	NH	E_2	P_4	EP	SEM
Egg weight (g)	49.50^a	46.70^b	43.15^c	46.85^b	2.08
Egg length (cm)	5.08^a	4.84^b	5.07^a	4.90^b	0.10
Egg width (cm)	4.06^a	3.70^c	3.80^b	3.85^b	0.10
Shell thickness (mm)	0.43^b	0.46^b	0 47^b	0.47^b	0.04
Albumen weight (% of EW)	63.48	3.47	63.95	63.65	0.62
Albumen height (cm)	8.25^b	8.40^a	7.95^c	8.20^b	0.10
Yolk weight (% of EW)	23.65	23.75	23.86	23.88	0.34
Yolk height (cm)	1.46	1.45	1.45	1.46	0.05
Yolk length (cm)	3.65	3.70	3.74	3.80	0.17
Yolk Index	0.40	0.39	0.39	0.38	0.01
Haugh Unit (%)	73.15	74.25	74.55	74.35	0.16

abcd: Means with different superscript are significantly different ($p < 0.05$)
SEM: Standard Error of Mean
NH = no hormone; E_2 = estradiol; P_4 = progestin; EP = estradiol + progestin

(Source: Alabi, 2020)

Mr Vice-Chancellor sir, artificial insemination (AI) is a widely used reproductive technology in the livestock industry that offers several benefits for animal reproduction and livestock improvement. It facilitates genetic improvement in livestock populations. AI allows breeders to use semen from superior males (sires) with desirable traits, fast growth rates, and disease resistance, to inseminate a large number of females (dams). This helps to rapidly disseminate superior genetics and improve the overall quality of the livestock population. It allows for precise timing of insemination, based on the female's estrous cycle, which can increase the likelihood of conception. AI also enables breeders to overcome breeding challenges, such as sub-fertility or mating difficulties, by using semen from fertile sires. AI can be a cost-effective breeding method, especially for small-scale farmers. It eliminates the need to maintain a male animal for breeding purposes, reducing feeding and management costs. In this regard, Ayoola et al.(2018), experimented to investigate the potential of *Telfairia occidentalis* (fluted pumpkin) leaf extract as a boar semen extender. In this study, the potential of *Telfairia occidentalis* leaf extract (TOLE) as an unconventional boar semen extender was compared to Beltsville thawing solution (BTS), a conventional semen extender over a 48-hour storage period. We reported that TOLE can be used to replace BTS as a boar semen extender at 50% concentration without loss of viability (Table 20).

Table 20: Effect of *Telfaria occidentalis* leaf extract as extender on boar semen extender

pH	Period (Hours)					
Extender	0	12	24	36	48	SEM
BTS	7.20^{c}	9.00^{a}	8.93^{a}	8.93^{a}	8.60^{b}	0.02
25%TOLE	6.85^{d}	7.90^{c}	8.72^{a}	8.65^{a}	8.35^{ab}	0.05
50% TOLE	6.63^{d}	7.71^{c}	8.47^{a}	8.32^{a}	8.11^{ab}	0.11
75% TOLE	6.25^{c}	6.62^{bc}	6.74^{b}	6.90^{ab}	7.05^{a}	0.12
Dead/Live (%)						
BTS	6.12^{d}	10.83^{cd}	12.83^{c}	13.32^{b}	17.67^{a}	0.18
25% TOLE	16.62^{e}	25.39^{d}	43.58^{c}	52.52^{b}	60.04^{a}	0.13
50% TOLE	10.50^{de}	15.59^{d}	24.64^{c}	31.78^{b}	38.70^{a}	0.12
75% TOLE	18.16^{e}	28.07^{d}	47.45^{c}	55.78^{b}	67.04^{a}	0.15
Sperm cell conc. ($10^3/cm^3$)						
BTS	252.01	252.05	251.10	249.11	248.15	1.18
25% TOLE	253.11	253.01	252.10	251.10	251.21	1.13
50% TOLE	255.21	255.13	253.15	253.01	252.03	1.12
75% TOLE	251.26	251.15	250.04	249.31	249.25	1.15

abcde Means along the same column with different superscripts are significantly ($P < 0.05$) different using Bonferroni as post hoc analysis

(Source: Ayoola et al., 2018)

4.4 Animal health

Ethno-veterinary medicine

The essence of good livestock management is to maintain them in good health with optimal performance without jeopardizing their welfare. Deterioration of the health condition of animals is an indication of bad management and poor welfare conditions. Therefore, livestock farmers must always monitor the health condition of their stock. Meanwhile, animal diseases can be managed through prevention and or treatment. However, prevention is better and cheaper than treatment. Either for prevention or treatment, the following methods are commonly used; medication, vaccination, and bio-security. In this era of organic farming and bio-safety, the need to incorporate orthodox medicine in animal science is inevitable. This made me venture into ethno-veterinary science and look for the possibilities of using some natural plant products to prevent and treat animal infection and infestation. Alabi et al.(2007), carried out an *in vitro* evaluation of crude sweet orange peel oil for acaricidal effect on cattle ticks. Orange peel is a common waste product in orange drink processing that usually constitutes an environmental nuisance. However, oil extracted from the fresh sweet orange peel was reported to be effective against cattle ticks (*Boophilus microplus)* at a dilution rate of 1:100. Similarly, Alabi and Dada (2022) investigated unripe orange peel oil for acaricidal effect on cattle ticks and reported that oil from unripe orange peel can be used to control cattle ticks when used pure or diluted at 1:10.

Meanwhile, a study on the awareness and perception of poultry farmers on the use of botanicals to manage animal diseases in Iwo Local Government was carried out by Aderemi et al. (2010) and we reported that few farmers are aware that natural herbs can be used to treat livestock ailments while majority depends on the use of drugs to treat their stocks.

Smart poultry health monitoring

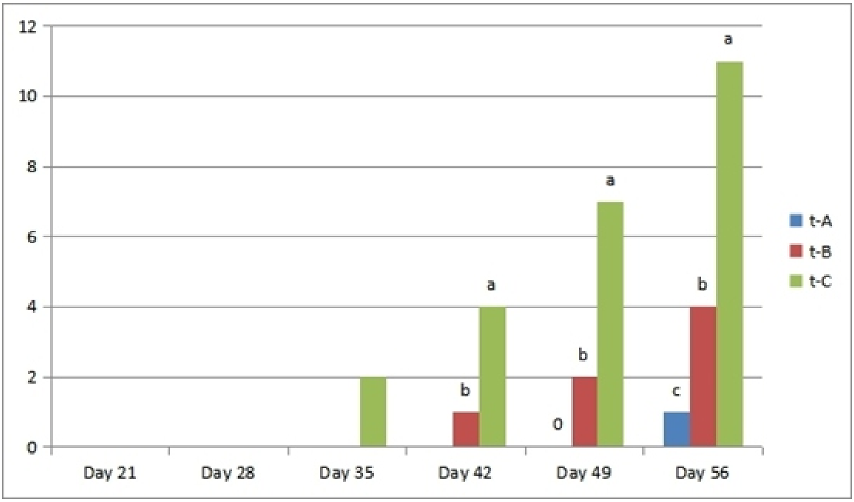
With the advent of smart agriculture, the need to monitor the health status of farm animals specifically chickens was looked into. In collaborative research with colleagues in the Computer Science

Programme, we collected data on images of the droppings from medicated and non-medicated broiler chickens both at the starter and finisher phases and also monitored their behaviors to form a basis for scientific comparison which may be useful for predictive purposes. Adebayo et al. (2023), and Aworinde et al. (2023b) reported that poultry health management can be enhanced through machine learning-based analysis of vocalization signals dataset. Also, Aworinde et al. (2023a) reported that poultry fecal imagery datasets can be used for early disease detection and poultry health status prediction. These research works revealed that computer-based and other electronic gadgets can be used to develop applications to predict and monitor the health status of our animals as these will sum up to good welfare for the animals. Also, Alabi et al. (2024), affirmed that medicated birds can perform better than non-medicated ones although, the role of passive immunity among non-medicated birds can not be overlooked. We also emphasized that with a good feeding regime and bio-security, non-medicated birds can as well perform optimally.

Litter management and poultry diseases

A deep litter system has been reported to be better than conventional battery cages from a welfare point of view, however, the litter material must be well managed so that it will not pose bad welfare for the chickens because of the tendency to harbor pathogens which can cause litter-borne diseases in chickens (Alabi and Akinoso, 2018). Alabi et al. (2024), reported that the incidence of pododermatitis was much more prevalent and severe among broilers reared on litter where the materials were not changed nor turned during the rearing period. We recommended that litter materials be replaced with fresh ones or be turned (raked) weekly to avoid the incidence of pododermatitis among broiler chickens. (Figure 7,8,9,10, 11 and Table 21).

Figure 7: Effect of different litter management systems on the incidence of Pododermatitis among Broilers at Finisher phase



t-A (litter replaced weekly); t-B (litter raked weekly); t-C (litter untouched)
abc: means with different superscripts are significantly different ($P<0.05$)

(Source: Alabi et al., 2024)

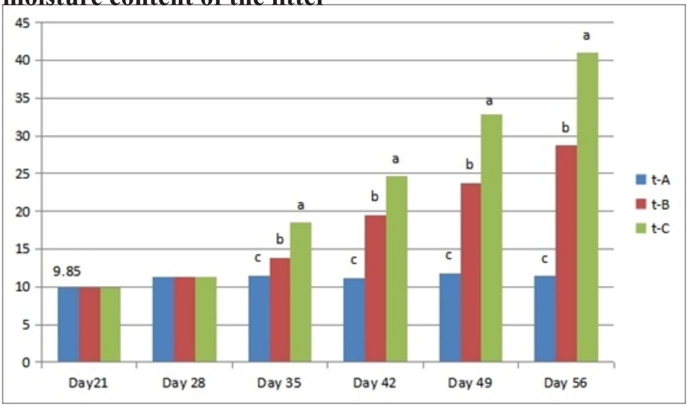
Figure 8: Chicken feet without pododermatitis

(Source: Alabi et al., 2024)

Figure 9: Chicken feet with severe lesions of pododermatitis

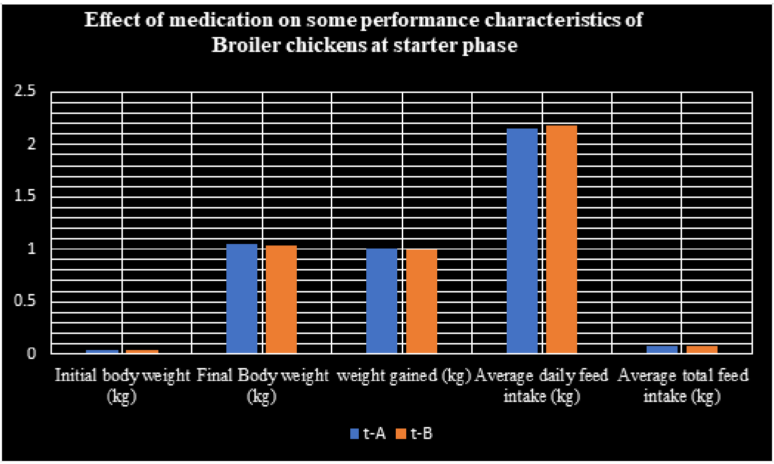
(Source: Alabi et al., 2024)

Figure 10: Effect of different litter management systems on the weekly moisture content of the litter



t-A (litter replaced weekly); t-B (litter raked weekly); t-C (litter untouched)
abc: means with different superscripts are significantly different (P<0.05)
(Source: Alabi et al., 2024)

Figure 11; Effect of medication on some performance characteristics of broiler chickens at the starter phase



(Source: Alabi et al., 2024)

4.5 Animal and human relationship

The way farm animals are being handled by humans from a welfare angle is very important. Many livestock farmers do not know that there is legislation to protect animals' rights against cruelty and bad welfare conditions. In developed countries, there are specifications on how animals should be housed, transported, and slaughtered so that there won't be infliction of pain and stress of any kind. This led to the ban on the use of battery cages for egg and meat-type chickens in European Countries and other parts of the Western world (Alabi et al., 2011c). The situation is not so in developing countries where the use of battery cages for housing chickens is still popular and remains unchallenged (Alabi, 2011b).

Alabi et al. (2014), and Alabi (2018) reported that the level of awareness of Nigerian citizens on issues of animal welfare is very low and therefore opined for mass education and further interpretation of animal rights and laws to the people. Alabi and Alabi (2020) found out that the Federal Ministry of Agriculture and Rural Development (FMARD) has a unit saddled with the promotion of animal welfare ethics, however, their work was being slowed down by the economic, socio-political situation of Nigeria, and poor attitude of livestock farmers toward the subject matter.

There has been a persistent conflict of interest between humans and animals in the wild. Ajayi and Alabi (2024) reported that animals being kept in game reserves established by governments are no longer safe as they are being hunted and killed illegally by people living close by. A study carried out by Ajayi and Alabi (2024) on the Akure-Ofosu forest in Ondo State revealed that human activities such as bush burning, deforestation, and illegal hunting have depopulated the animals therein while many species have gone into extinction. To curb this menace, there is a need for strict enforcement of animal welfare laws in Nigeria (Ajayi et al., 2024).

The welfare of animals in transit from one place to another is very important. Animals are usually transported from one place to the other. It can be from the farm to the processing center or from the farm to the marketplace place the distance of which may be short or long. In Nigeria and other developing countries today, cattle transportation is horrible with animals being packed together in trucks for journeys that may take several days (Figure 12).

Figure 12 - 14: Bad ways of transporting cattle in Nigeria

Figure 15: Humane transportation of broiler chickens

They will remain standing throughout the trip with no access to feed, water, and bedding. Some may die in transit while others may sustain permanent injuries. Even, some people are using motorcycles and tricycles to transport cattle (Figures 13 and 14).

Animals are supposed to be transported humanely with enough space and provision for cross-ventilation (Figure 15). Animals transported over short and long distances must be given anti-stress to help them get over the agony of the trip.

In a collaborative research, Ayoola et al.(2023) compared the use of synthetic vitamin C and orange juice as anti-stress for broiler chickens transported over a long distance. We concluded from the results obtained that the oral supplementation of natural sources of ascorbic acid (*Citrus sinensis*) and synthetic vitamin C helps to ameliorate the effect of transportation stress. *Citrus sinensis* extract (

sweet orange juice) can therefore be used by farmers and livestock transporters as an anti-stress for their animals before and after the journey.

Finally, farm animals must be slaughtered in a way that will not make them feel the pain of death. They must not be subjected to any form of stress or cruelty during the process and must be be rendered unconscious before being bled. This humane slaughter procedure is welfare compliance which will also improve their carcass quality for human consumption (Alabi, 2023).

Inhumane slaughter=bad welfare

Bad processing of animal leads to unsafe products…..

5.0 Future direction of my research

Mr Vice-Chancellor sir, you will agree with me that today's event marks the beginning of another phase in my academic career. There are a lot of challenging issues to be addressed via meaningful research in collaboration with other colleagues toward making livestock production a sustainable one in Nigeria without jeopardizing the welfare of our animals. I wish to carry out more research works on:

1. Amelioration of stressful conditions of poultry species and small ruminant animals via color perception, enriched housing, and stereo-imaging
2. Bio-castration for swine and small ruminants

3. Husbandry of neglected micro-livestock

Above all, as an animal welfare advocate, I wish to work more with other organizations within Nigeria and abroad to promote issues of and or create more awareness of animal welfare.

6.0 Conclusion and recommendations (the quest for animal welfare)

According to Mahatma Gandhi; "*The greatness of a nation and its moral progress can be judged by the way its animals are treated*".

Mr. Vice-Chancellor sir, fellow scholars, distinguished ladies and gentlemen, having taken you through the basics of the inseparability between animals and humans, I wish to conclude that livestock farming is unarguably source of food, employment, income for people in developing countries of the world, Nigeria inclusive, and therefore must be intensified. However, there is a need for livestock farmers and animal handlers to take good care of their stock and afford them the 5 Freedoms of animal welfare:

i Freedom from hunger and thirst

ii Freedom from discomfort

iii Freedom from pain, injury, or disease

iv. Freedom to express normal behavior

v. Freedom from fear and distress

Furthermore, I wish to propose the following recommendations emanating from my research voyage as pointers toward the improvement of the welfare of our farm animals:

1. Ingredients meant for animal feed must be of very high quality and free of anti-nutritional factors that can affect them physiologically.
2. The health status of farm animals can be boosted with the use of local herbs and botanicals so also the reproductive efficiency
3. Farm animals must be housed in a conducive environment void of overcrowding, well-ventilated with freedom to move about.
4. Painful animal husbandry operations on the animals such as

castration, dehorning, debeaking, and tail docking must be avoided as much as possible

5. The welfare of animals during transportation from one place to another is very important. Therefore, farm animals must be transported under stress-free conditions.
6. Farm animals must not be slaughtered with cruelty. Humane slaughter procedures must be strictly adhered to.
7. There is a need to create awareness of the existence of laws (or part of laws) that protect the rights of the animals in Nigeria. Academic groups, trade groups, and other professional organizations can also be involved. This is a challenge to the Federal Ministry of Agriculture and Food Security, the Nigerian Institute for Animal Science, and other professional groups.
8. Government needs to create an enabling environment to enforce animal protection laws
9. There is a need for capacity building among livestock farmers on how to avoid being cruel to the animals
10. More experts are needed in the area of animal welfare and animal rights protection
11. Principles of animal behavior and welfare must be incorporated into the curricula of all science-based Programmes and Sociology Programme
12. Basics of animal rights and laws must be incorporated into the curricula of the Law Programme

7.0 Acknowledgments

Bowen University

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