The State of Animal Biotechnology Practices and Biosafety Regulation in Nigeria

4th International Workshop on Regulatory Approaches for Animal Biotechnology

SYLVANUS IKENNA OMEJE*
ROSE SUNISO GIDADO, PhD **

*Professor at Delta State University Abraka, Nigeria; Natl. Coordinator, Animal Breeders & Geneticists Network Nigeria (ABGeN-NG)

**Country Coordinator, OFAB Africa, Nigeria Chapter; Deputy Director, Agric. Biotech Dept. at National Biotechnology Devt. Agency (NABDA)

October 7, 2020

INTRODUCTION

- Agriculture is the world's largest industry employing more than 1.0 billion people with over $1.3trilion USD accruing from the sector annually (worldwildlife.org)
- With the over 7billion global human population which is still steadily rising demands for agricultural produce also keep rising
- Nigeria's current human population is a little above 207 million (UN Data, Worldometer, 2020) and with the current nominal GDP of USD250 Billion, Nigeria is both the most populated country and largest economy in Africa.
- Nigeria's wealth is hugely derived from the oil and gas industry but (unfortunately) less than 25% of her annual national revenue comes from the agricultural (21.91%) and other sectors (3.09%) of her economy .
- In view of this sectoral imbalance in the country;s economy the Nigerian State has made steady effort at addressing the issue and to relaunch Agriculture to the forefront as her mainstay of the economy, Which, was the position it was occupying during the pre-independence era (before 1960) up to when petroleum was prospected and produced in the early 1970s.
- This shift became imperative because, unlike the oil and gas industry, agriculture is the one and only sector that provides employment to more than 70% of the country's skilled (and unskilled) labour.
- And besides, the country's population keeps shooting up implyimg the need for more food and the most conducing environment to produce safe and adequate food.

NIGERIA'S AGRO-BASED INSTITUTIONAL FRAMES AIMED TO MEET FOOD & ECONOMIC NEEDS

- There are 15 national agricultural research institutes (NARIS) established by the Government between 1924 and 1977
- Four of these are livestock based out of which 2 have mandates for fisheries, 1 for animal health and another 1 for farm animal production
- On the other hand, there are 38 Universities in Nigeria approved for the study of agriculture and agricultural technology out of which 5 are privately owned.
- Thus, animal production and biotechnology research is left in the hands of the 4 institutes and the universities, and
- in the hands of a few agro-biotech industries and multi-national organizations represented by their agencies in Nigeria

Mandates of the 4 Livestock & Fisheries Research Institutes Relevant to Animal Biotechnology

- Natl. Animal Prod. Res. Inst. (NAPRI), A.B.U., Shika, Zaria (1977): genetic and reproductive improvements of farm animal spp.

- Natl. Inst. For Freshwater Fisheries Res. (NIFFR), New Bussa (1968): genetic improvement, production & processing of freshwater fisheries spp & effects of manmade lakes and water bodies on fisheries ecology and environment.

- Nig. Inst. for Oceanography & Marine Res.(NIOMR), Lagos (1975):genetic improvement, production & processing of brackishwater and marine fisheries.

- Natl. Veterinary Res. Institute (NVRI), Vom (1924):all aspects of animal health & diseases; development and production of animal vaccines and sera.

BIOTECHNOLOGY PROMOTION AGENCY & BIOSAFETY REGULATORY AGENCY

- Aware that no clear mandates on biotechnology development and regulations on its products have been given to the Agricultural Research Institutes or to the Universities far back at their inceptions.

- The Nigerian government has in the past decade created two bodies with powers to promote biotech practices, and to handle biosafety laws to guard both the human health and the environment against potential adverse biotech effects.

- The two bodies created were the National Biotechnology Development Agency (NABDA) established in 2001, to promote, coordinate and deploy “cutting-edge” biotechnology R & D processes and products for the socio-economic well-being of the nation.

BIOTECHNOLOGY PROMOTION & BIOSAFETY REGULATORY AGENCIES (2)

- **The second agency established by government is regulatory by ordinance:**
  - The National Biosafety Management Agency (NBMA) established in 2015, to regulate modern biotechnology activities and products released into the environment, using the domesticated Protocol of the global Biosafety Act to address Nigeria's biosafety requirements.
  - As contained in the Amendment Act 2019 the NBMA was also charged with the responsibility of putting in place guidelines for 'Gene editing, Gene drive, Biosecurity and Synthetic Biology'.

SOME SPECIFIC MANDATES OF THE NBMA ON THE ENVIRONMENTAL (CONTAINMENT) & OTHERS

- Laboratory procedures on transformation, resuscitation, incubating of the transformed generative cells and tissues as well as the rearing and observations on the genetically modified animal/organism to be carried out in complete containment environments;

- All the genetically edited/modified organisms shall be observed under complete containment in an experimental environment that will simulate the climatic, microbial, and communal characteristics of the intended locations of release.

- The observations shall include the condition of the transgenic animal and those of its microorganisms during gene transfer and those of the microbial plant and animal communities in the experimental area;

- Limited release shall be carried out in an area with appropriate enclosure and emergency measures taken to prevent escape, and their observations to include the conditions of the genetically modified organism, its micro-organisms and the ecology of the microbial, plant and animal communities in the enclosed area.

- If the animal is intended to yield a product, the regulation guiding the release of the product shall follow the procedure in paragraph (bullet) #4 above.

- The spread or distribution and behavior of any released genetically modified animal or organism shall be monitored for at least 30 years.

Background to Nigeria's Animal Biotechnology Practices

- SL **The practice of animal biotechnology officially began from 1861 to 1873 when Commander John Hawley Glover was the Proconsul of the Lagos Colony in (then) Southern Protectorate of the present Nigeria.**

- SL **It started with reproductive biotechnology, when Glover directed all native cockerels be replaced with males of the Rhode Island breed.**

- SL **Whereby villagers who participated in the 'village chicken improvement scheme' were asked to release all their native males which were provided with post-brood males of the RIR.**

- SL **Hence the presence of the reddish hackle feathers on the necks and the reddish tail coverts of most native cocks found in Nigeria even today.**

- SL **The first successful artificial insemination (AI) in Nigeria was carried out in National Veterinary Research Institute (NVRI), Vom in 1943 using imported Friesian cattle semen cryo-preserved and processed at the Cattle Stock Centre (present NAPRI) , Shika, Zaria.**

DEVELOPMENTAL STRIDES OF NIGERIA'S ANIMAL BIOTECHNOLOGY

- **With the successful AI process at Vom and Shika artificial insemination became the adopted practice in Kano, Agege Dairy farm, Lagos, Obudu Cattle ranch , Mokwa Cattle Ranch and in many other ranches across the country.**

- **Today modern reproductive and breeding techniques have been obtained through private firms based in Lagos and Ogun State using frozen ova and semen of world's best cattle , goat and sheep breeds.**

- **The chicken, swine and rabbit semen collection procedure adoptions have long been perfected in Nigeria as well using semen extension with readily available diluents and extenders in most Teaching and Research farms of many Nigerian universities (especially at the University of Nigeria, Nsukka, far back in 1981).**

- **Selective breeding technology together with AI in Avian ad other livestock species is a common practice in most Nigerian Universities Research Farms.**

INSTITUTIONAL ACHIEVEMENTS & COLLABORATIONS IN ANIMAL BIOTECH (1)

- Notable breakthroughs in animal biotechnology projects and studies have been achieved by some research institute and universities:
- The development and production of 1st Made in Nigeria breed of layer-type chicken, the Shika Brown, by the NAPRI, A.B.U., Zaria, in 2000 .
- This project took 15 years to accomplish; started in 1985 by a team of experts led by Professor S. Nuru, V. Buvanendran and S.I. Omeje, using selective breeding combined with performance testing(PT) across the agro-ecological zones of the country.
- Development and production of Nigeria's 2nd breed of dual purpose breed of chicken, the FUNAAB Alpha by the Fed. University of Agric., Abeokuta, in 2018 using molecular technique, selective breeding and PT.
- Since 2018 FUNAAB, led by Prof. (Mrs) A.O. Adebambo with her team, has added the broiler and egg- type chicken breeds, and the KalaWAD goat.

INSTITUTIONAL ACHIEVEMENTS & COLLABORATIONS IN ANIMAL BIOTECH (2)

- The University of Nigeria, Nsukka (UNN) has developed the Heavy (dual purpose) and Light (egg type) ecotypes of the native chicken using selective breeding and molecular approaches.
- Led by Emeritus Prof. C.C. Nwosu with Prof O.M Momoh & other scientists, the UNN project began in 2002;
- work on the use of genomics to identify polymorphic sites associated with egg production and body weight development of both ecotypes is at the conclusive stage at Nsukka.
- The Obafemi Awolowo University's AR&T, Ibadan, developed the NigerHy B pig breed.
- Other breakthroughs have equally been made by institutions and by scientists in the various universities working in different areas of Animal Biotechnology (Animal health, Reproduction and Molecular Genetics, Food and nutrition, Growth and production

INSTITUTIONAL ACHIEVEMENTS & COLLABORATIONS IN ANIMAL BIOTECH (3)

- The NVRI, Vom, has perfected the techniques:
- For rapid diagnosis of poultry and livestock diseases eg HPAI, ND, PPR, rabies and ASF diseases.
- To assesses the immunogenicity of the recombinant HA, NA and use the clones in chicken as models
- Develop one step H5AIV antigen test protocol for rapid field and laboratory diagnosis of H5N1 AIV in Nigeria.
- The institute is also using RT-PCR based approach to:
- detect, amplify and isolate HA and NA genes from H5N1 subtypes identified in Nigeria;
- sequence and analyze HA and NA genes of G5N1 subtype in Nigeria,
- clone and express the HA and NA genes in various vectors to identify the best vector for the genes.

Vaccines in Production and under trial

Animal Species	Organism	Vaccine Type
Cattle	Bacterial	Contagious Bovine Pleuropneumonia (CBPP)
Cattle	Bacterial	Haemorrhagic Septicemia Vaccine (HSV)
Cattle	Bacterial	Black Quarter Vaccine (BQV)
Cattle	Bacterial	Antrhax Spore Vacine (ASV)
Cattle	Bacterial	Brucella S-19
Cattle	Bacterial	Hantavac
Sheep/Goats	Viral	Peste des Petits Ruminants (PPR) vaccine Kata
Sheep/Goats	Viral	Sheep and goat `pox
Cattle	Viral	Lumpy Skin Disease**
Cattle	Viral	Foot and Mouth Disease**

NATIONAL VETERINARY RESEARCH INSTITUTE, VOM. NIGERIA

Vaccines In Production

Animal Species	Organism	Vaccine Type
Poultry	Bacterial	Fowl Cholera Vaccine (FCV)
Poultry	Bacterial	Fowl Typhoid Vaccine (FTV)
Poultry	Viral	Newcastle Disease Vaccine intraocular (NDV i/o)
Poultry	Viral	Newcastle Disease Vaccine intraocular (NDV L)
Poultry	Viral	Newcastle Disease Vaccine Komorov (NDV K)
Poultry	Viral	Newcastle Disease Vaccine (NDV) I-2
Poultry	Viral	Fowlpox Vaccine (FPV)
Poultry	Viral	Infectious Bursal Disease Vaccine (IBDV) Gumboro
Dog	Viral	Anti-Rabies Vaccine Dog (ARV D)

NATIONAL VETERINARY RESEARCH INSTITUTE, VOM. NIGERIA

NATIONAL VETERINARY RESEARCH INSTITUTE, VOM. NIGERIA

INSTITUTIONAL COLLABORATIONS IN ANIMAL BIOTECH STUDIES (1)

1.University of Port-Harcourt(UNIPORT), Michael Opara Univ. of Agriculture(MOUA), University of Benin(UNIBEN) &Rivers State University(RSU).

- SL **In a non-synonymous polymorphism study by Benneth, Agaviezor, and Orheruata in 2019 the melanocortin 1 receptor gene was found to be consistently associated with higher body weight among Black and White coated rabbits, thereby suggesting preference for rabbits with Brown with White patched coat colours to meet breeding objectives for body weight improvement in rabbits.**

- SL **Earlier this year (2020) Agaviezor and Oleforuh-Okoleh revealed DNA polymorphism, gene flow and genetic differentiation in the MC3R gene across Nigerian indigenous Naked Neck, Frizzled feathered and the exotic ISA Brown chicken breeds, which can guide in improving and conserving the Nigerian indigenous chicken breeds.**

- SL **In another genetic diversity study this year involving the pituitary transcription factor 1 (PIT 1) gene in Nigerian local and exotic chicken, Agaviezor and Chukwuemeka found high numbers of haplotypes, indel sites and within-breed evolutionary divergence over sequence pairs in ISA Brown layer chickens compared to the Shika Brown and Naked Neck chickens, providing a clearer guide to better conservation and breeding programs.**

- SL **On the other hand Ologbose, Oke, Nwachukwu, Agaviezor, and Ajayi, this year found that single nucleotype polymorphisms of the growth hormone gene had associations with growth traits of crossbred swine where by the growth gene G>A genotype had higher growth trait values than the G>G genotype and that G>A genotypes had a stronger correlation with higher body weight than G>G genotypes; indicating that these SNPs may be useful indicators in selecting for higher growth and meat yield in pigs .**

INSTITUTIONAL COLLABORATIONS IN ANIMAL BIOTECH STUDIES (2)

II. **University of Agriculture Abeokuta(UNAAB),University of Ibadan(UI) & Obafemi Awolowo University(OAU).**

- SL **At the FUNAAB:** Genetic diversity of goats indigenous to Nigeria is high based on analyses of mitochondrial DNA (Bemji*et al*., 2014; Awotunde *et al*, 2015) and microsatellite markers (Muritala et al., 2015).
  - 2. Polymorphism scanning and genotyping of candidate genes associated with litter size in goats namely: gonadotropin-releasing hormone receptor (*GnRHR*) gene (Bemji*et al*., 2017) and inhibin alpha (*INHA*) gene (Isa *et al*., 2017) revealed novel SNPs with strong linkage disequilibrium.
  - 3. For *GnRHR* gene, significant association was found between allele G at g.-29T>G locus, with higher mean litter size for homozygous GG mutant does compared with GT or TT genotypes.
  - 4. For *INHA* gene, polymorphism at g.3234C>T locus could serve as baseline genetic marker for litter size in West African Dwarf goat since heterozygous CT does had significantly (p = 0.01) higher litter size than homozygous CC mutant.
- UZ At University of Ibadan (UI), works were done decades ago on the successful collection and preservation of pig semen using laid out techniques,
  - introductions of automated mating platform using artificial cervix & locally fabricated mount,
  - and locally modified refrigeration, thermo-regulated at 17oC and successfully used for semen storage.
- UZ At the **IAR&T (OAU) the NigerHyB pig breed has been developed.**
- UZ At the OAU, Ile Ife, remarkable findings have been made by Prof S.O. Oseni and his team on the canonical and multivariate discriminant studies of the plumage colour variants of the Nigerian native turkey and cephalic morpholgies of native breeds of sheep , setting the stage for genomic confirmation of the exact genetic identities those meleagrine and ovine species.

INSTITUTIONAL COLLABORATIONS IN ANIMAL BIOTECH STUDIES (3)

III. Delta State University(DELSU,) Federal University of Technology, Owerri(FUTO) & University of Nigeria Nsukka (UNN).

- The insulin-like growth factor (IGF) gene in the liver of grower pigs fed sweet potato meal (SPM) and maize based diets were studied by Pro S.I.Omeje, Prof L.Bratte and Dr M.Moemeka in 2019 at DELSU, Abraka recorded the highest expressivity in pigs fed 100%SPM diet; increased the levels of glutathione peroxidase antioxidant enzyme known to prevent cell death as it lowers blood sugar, improves insulin sensitivity and raises triglyceride levels in grower pigs.

- In a swine genomic study in 2019 at DELSU by Prof S.I.Omeje, Prof I.Udeh and Dr G.U.Sorhue , 216 out of 459 loci of the growth hormone (GH) gene monitored were detected to be affected by single nucleotide polymorphism with a maximum of 3 alleles/locus in all the polymorphic loci; providing indices of the mean number of alleles, and unbiased diversity profiles of the pig population.

- The influence of SNP of the chicken growth hormone (cGH) gene on the linear morphometry and performance of three chicken genotypes in Nigeria was studied at FUT Owerri in 2019 by Profs U.E.Ogundu , C.I.Okoli, and Drs V.M.Okoro and O.L. Okafor, in which two base pair substitution mutations (CC>CA and GG>GT) were found at different loci of the cGH gene in Funaab Alpha and in Shika Brown and local chicken respectively , associating significantly with the morphometry and production traits.

- At the UNN work on the polymorphism of the prolactin receptor gene and its effects on body wt, and egg production traits of the Heavy Ecotype of Nigeria's local chicken is on going by Emeritus Prof C.C. Nwosu, Dr H.N. Foleng and F. Udeh.

Biotechnology and Biosafety Regulation Agencies in Nigeria: Challenges.

- As decades role by, successive governments have initiated policies to grow Nigeria's agricultural sector, but the country remains a net importer of food and agricultural products (~$7 billion per annum).
- Lack of infrastructure, absence of effective policy formulation and implementation, insecurity, negative impacts of climate change, continues to impede Nigeria's agricultural growth.
- The National Biotech. Dev. Agency (NABDA): since 2001, mandated to promote, commercialize biotechnology products.
- In it's 1st decade, NABDA recorded impressive national awareness achievement on biotech practices and application potentials.
- In response, government publicly proclaimed intents to commercialize agric-biotechnology as a means to achieving food security in the country.
- Interestingly, against the NABDA's successes, some civil society groups and environmental activists emerged; intensifying their anti-GE campaigns.

Biosafety Regulatory Agency in Nigeria: Challenges (1)

- Then in 2015 the biosafety law-- establishing the National Biosafety Management Agency (NBMA) -- was established, and became the biosafety regulatory authority and focal point.

- NBMA is providing oversight for the use biotechnology and regulating the commercialization of biotechnology products.

- the NBMA law leans heavily on the precautionary approach, and thus requires certification and mandatory labelling for imports of all biotechnology products; especially products containing genetically engineered (GE) products or ingredients exceeding 4%.

- In spite of NBMA and its mandates agitations against biotech applications and free distributions and consumptions of its products still persist, coupled with palpable feeling about free influx of imported seeds and stock of unknown or certified quality for farming and propagation in Nigeria.

- And as we speak people in the streets and hinterlands cannot tell any differences between GE and non GE foods and seed stocks.

CONCLUSION

- Animal biotechnology has tremendous potentials to improve food security and reduce malnutrition in Nigeria.

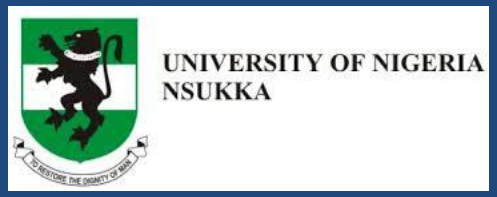
- The practice of animal biotechnology is not without challenges as Nigeria is still faced with inadequate research facilities and funding;

- Increasing anti-GE food and other biotech products amidst heightened biosafety fears, and massive food insecurity given the swelling human population.

- No matter the situation, the probable solution should be to work for farmers', producers, consumers' and the general public's positive attitudes towards biotechnology in this country to be leveraged towards better orientation and proactivism in biotech and biosafety approaches.

- Meaning that Nigeria has to develop more effective strategic risk communication to address the anti-GE misconceptions and related phobia, and steer the masses to embrace the benefits of modern agricultural (or animal) biotechnology under biosafety environments.

Thank You For Listening



Contact:

National Biotechnology Development Agency
Along Airport Road, Lugbe, P.M.B.5118, Wuse, Abuja.
Phone : 09-6715691, 09-3145473
Website: www.ofabnigeria.com
Email: nabdamails@yahoo.co.uk,
ofabnigeria@gmail.com

Twitter: @OFABNigeria
Facebook: www.facebook.com/ofabnigeria
Linkedin: www.linkedin.com/ofabnigeria
Youtube: ofabnigeria