



PHYTOGENICOLOGY: A NOVEL STUDY FOR EFFICIENT USE OF PHYTOGENICS IN MONOGASTRIC NUTRITION

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Abstract

In this commentary a case for scholarly study of bioactive plants (Phytogenicology) used in monogastric animal feeds is made. Plants and their extracts have for decades been used by man in food and medicine. Spices such as black pepper and thyme have been used to improve acceptability of human foods. These plant materials contain certain substances that make them potent and beneficial in some aspects of human nutrition and health. Their potency has made them to be regarded as phytogenics exhibiting antimicrobial and antioxidant properties. Human being share certain things in common physiologically, biochemically and nutritionally with monogastrics and having similar gut architecture. The success story of phytogenics in human nutrition has led to the current surge in their use in monogastric nutrition. Incorporating Phytogenicology as part of the curriculum in the study of animal science, animal production or animal husbandry is important to unveil their growth and health promoting potentials, possible implications of their application and their sustainable use.

Keywords: bioactive plants, monogastric animal, phytogenicology, spices.

Introduction

Phytogenicology or Phytogenical Science is a word coined by Ndelekwute *et al.* (2017) which means the study of spices, plants parts, and plant extracts in relation to their application in farm animal nutrition and nutrition-related health challenges. This entails the study and use of extracted bioactive molecules in plants or plant parts in processed form to solving nutrition and nutrition-related health challenges in farm animals. These biologically active products which are regarded as phytogenics include herbs, roots, barks, woody parts, flowers, seeds, fruits and pods of plants that are medicinal. Some are pungent in nature such as spices (Windisch *et al.*, 2008). According to Sharifi *et al.* (2013) there have been strong interests recently in use of these products in animal feeds especially the monogastric types (swine and poultry). This interest according to Ndelekwute *et al.* (2017) needs to be sustained through integrated approach. ranging from:

- * Scientific study to determine their active ingredients.
- * Determining their properties and the behaviour of the active molecules at certain conditions (temperature, interaction with feed components etc.)
- * Determination of toxic substances in them and their toxic levels in feeds.
- * Massive feeding trials using different animals including pets in determining their effect on farm animal productivity.
- * Determining the possibility of using them in curbing some nutrition challenges in animal nutrition and health.
- * Cultivation of such plants in commercial quantities.
- * Good processing and packaging of the products for commercial purposes.

The tropical ecosystem of Africa, Asia, South and Central America is blessed with massive natural green biomass which could be explored. Use of medicinal plants and spices in human health and nutrition has been recognized and is advancing in many countries. In developing countries such as in Africa, the knowledge and interest is increasing. In Nigeria for instance, herbalists or traditional medicine experts (phytotherapists) use herbs, roots and tree barks to manage human infections caused by bacteria, fungi, helminthes and protozoa - the same organisms confronting swine and poultry. In human also, digestive



disorders and conditioning of the digestive system of nursing mothers are managed using some of these products like spices such as *Xylopiiaethiopica* (Omodamiro, 2012) and plant extracts (Sharifi *et al.*, 2013). Information and knowledge derived from human experience could be a necessary tool in developing a framework for studying, developing and utilizing these products in feeding of farm animals, especially swine and poultry which have similar gut architecture and digestion pattern as human. This can be achieved through collaborative efforts involving different experts in agriculture such as the animal nutritionists, animal physiologists, veterinary pathologists, biochemists, agronomists, traditional phytotherapists and knowledge from pharmacognosy. Apart from their biochemical make up, knowledge of their microbiological, serological, histopathological, endocrinological, immunological enzymological, metabolic and reproductive effects are important. Best agronomic practice for their cultivation, their processing, storage and packaging should also be scholarly studied. Their use in monogastric nutrition is growing because of certain performance challenges such as lipid oxidation, gut microflora, digesta fermentation, flatulence and reduced nutrient digestion and absorption in the face of global withdrawal of dietary antibiotics in farm animals. The objective of this work is to intensify efforts in the search for alternative bioactive plant materials to replace antibiotics in animal nutrition by advocating for the study of Phytogenics as a core area of the search and not only by feeding trials.

Nutritional Challenges and Current Solutions Adopted to mitigate them.

Performances of farm animals both in health and productivity needs to be enhanced through proper utilization of nutrients contained in the feed. Improper utilization of nutrients due to inadequate digestion and absorption could undermine the health status and productivity of farm animals Choct (2009). Digestion and absorption of nutrients by the intestine are key processes leading to nutrient utilization. These important processes could be undermined or hampered due to the presence of fibre, non-starch polysaccharides, anti-nutritional factors, mycotoxins, rancid feed, gut pathogens, poor endogenous secretions by young chickens and piglets such as hydrochloric acid (Lee *et al.*, 2004; Kroismayr 2008; Odetallah, 2016).

Judging from the above mentioned challenges in monogastric animal nutrition, which enzymes, antibiotics and good processing of feedstuffs have been used to reduce to some extent, the official withdrawal of antibiotics from animal feeds has opened up another chapter in the “challenge” debacle. Antibiotics are known to modulate the gastro intestinal tract (GIT) of swine and poultry. Their withdrawal has been reported to lead to proliferation of microorganisms in the GIT with the attendant nutrient fermentation, poor nutrient absorption and poor productivity (Dibner, 2004). The GIT must be in good health condition to be able to process feed, even when enzyme is added. The question could be;

Can the GIT be in good condition to respond appropriately in antibiotic-free state? Considering the fact that enzymes will only break down feed, a product with multi - dimensional efficacy is required which will modulate and prepares the gut for effective absorption of nutrients. Phytogenics such as organic acids, essential oils, spices etc. could achieve this feat (Canibe *et al.*, 2008). This assertion could be supported by the following facts about phytogenic materials.

- * They have complex and mixed molecules that are bioactively important such as phenols, organic acids, essential oils, lycopene, flavonoids, sulphorephene, tocopherol, carotene which act as antioxidants and antibiotics.
- * They are naturally renewable. Their natural sources (plants) could be cultivated on farms at commercial level.
- * Their active ingredients such as essential oils and organic acids are well metabolized by the liver and report of negative residual effect is scarce.
- * They are environment friendly because environmental toxicity has not been established for their use in feeds. Hence environmental contamination which is for instance associated with phosphorus and protein is not likely. This could positively attract commendation from environmentalists who have been pushing for sustainable environment in animal production.



- * Bacteria resistance resulting from their inclusion in feeds has not been reported.
- * Aromatic phytogetic materials such as spices have sensory qualities, and add flavour to feeds which improve palatability (feed acceptance by animals).
- * With the campaign for organic agriculture which is in the increase, these products are good window to achieving that.
- * Their recognition in animal nutrition, could lead to increase in employment in tropical environments, through cultivation of such plants, processing, packaging and marketing.

The Potency of Phytogetics

Naturally, bioactive plants and their products are embedded with numerous organic compounds ranging from carotenoids, flavonoids, organic acids, phenols and essential oils. All these compounds have different and similar properties and mode of action. This means that when they are added to feed, challenges such as fat oxidation, nutrient fermentation in the gut, flatulence, poor digestion and absorption can be mitigated. Synergy between the bioactive compounds could lead to better results of improved growth, feed efficiency and general productivity which have been reported by Windisch *et al.* (2008). This synergy could also be improved when more than one phytogetics are combined, each contributing its different bioactive compounds, thereby generating positive interactions.

Essential Investigations that are Necessary

Though phytogetics have been recognized to have the potential to improve productivity in animal agriculture it is important that their mode of actions and their likely dietary implications be studied. In this regard, their study should also be centered on their;

- Microbiological effect in the feed and in the gastro intestinal tract.
- Serological effect, determining their impacts on the blood cells, serum protein and liver enzymes.
- Histopathological effect noting their impact on internal organs such as the liver and kidney.
- Endocrinological effect, understanding how they affect the release of hormones such as insulin, thyroxin, glucagon, sex hormones, reproductive hormones and their activities.
- Immunological effect studying their stake on immune system in the area of mucus secretion and production and activation of antibodies especially immunoglobulin (IgA).
- Enzymological effect knowing their place in secretion, activation and activities of enzymes of digestion (pepsin, trypsin, chemotrypsin, amylase, sucrase, lipase etc.).
- Metabolic effect, determining whether they have significant role in biosynthesis (e.g. protein accretion) and breakdown of organic compounds (e.g. energy generation) in the body such as having similar role as cofactors and coenzymes.
- Gut anatomy influencing the number of villi, height of villi, crypt depth and gut length.
- Reproductive effect noting their impact on oogenesis, ovulation, fetus implantation, spermatogenesis, semen quality (volume, colour, viscosity), erection, sperm count and sperm morphology.
- Muscular effect, inquiring whether they act as stimulants.
- Uterine effect studying their effect on feotal development and their relationship with oxytocin and vasopressin.
- Mammary effect unveiling their effect on milk synthesis and milk letdown. Their relationship with oxytocin.
- Product quality effect investigating their impact on egg quality (shell colour, shell thickness, yolk colour, albumen height), nutritive value and organoleptic property of meat, milk quality (taste, colour, nutritive value).

Conclusion



Phytogenic substances have shown great potentials in tackling some of the problems posed by anti-nutritive factors in some feedstuffs and the challenges of official withdrawal of antibiotic feed additives in feeds for farm animals. These substances have bioactive compounds in complex forms which exert synergic action in animals. Their great advantage is that they abound naturally in our ecosystems especially in tropical green environment, they can be cultivated which could lead to sustainable productivity of farm animals. Their comprehensive study and inclusion in curriculum of Animal Science is vital to critically and fully harness their potentials.

References

- Canibe, N, Emberg, R.M. & Jensen, B.B. (2008). An overview of the effect of organic acids on gut flora and gut health. *Asian J. Poul. Sci.* 53, 75 – 78.
- Choct, M. (2009). Managing gut health through nutrition. *British Poul. Sci.* 50(1): 9 – 15.
- Dibner, J. (2004). Organic acids: can they replace antibiotic growth promoters. *Feed Int.* 25(12): 14 – 16.
- Kroismayr, A. (2008). Lignocellulose – fresh wood as dietary fibre. *Pig Progr.* 4(24): 33 - 35.
- Lee, K.W., Everts, H., Kappert, H.J., Van Der Klien, J., Lemmens, A.G. Frehner, M. & Beynen, A.G. (2004). Growth performance, intestinal viscosity, fat digestibility and plasma cholesterol in broiler chickens fed a rye-containing diet without or with essential oil components. *Int. J. Poul. Sci.* 3(9): 613 – 618.
- Ndelekwute, E., Okereke, C., Assam, E. and Iwunna, D. (2017). Phytogenicology: an emerging field of study for productivity and sustainable environment in monogastric animal production. *Int. J. Agric. Environ. and Biores.* 2(3): 483-493.
- Odetallah, N. (2016). The impact of phytase on nutrient utilization of animal feed. *Int. Poul. Prod.* 24(4): 15-17.
- Omodamiro, O.D, Ohaeri O.C & Nweke, I.N. (2012). Oxytocic effect of aqueous, ethanolic, n- hexane and chloroform extracts of *Xylopias aethiopica* on guinea pig uterus. *Asian J. Plant Sci. and Res.* 2: 73 - 74.
- Sharifi, S.D., Khorsandi, S.H., Khadem, A.A., Salehi, A. & Moslehi, H. (2013). The effect of four medicinal plants on the performance, blood biochemical traits and ileal microflora of broiler chicks. *Veterinarski Arhiv*: 83(1): 69-80.
- Windisch, W., Plitzner, K. C., & Kroismayr, K. (2008). Use of phytogenic products as feed additives for swine and poultry. *J. Anim. Sci.* 86 (E. Suppl.), E140 - E148.