BIODEGRADATION OF AGRO INDUSTRIAL BY PRODUCTS AS A PANACEA TO FEED SCARCITY IN NIGERIA AMIDST FARMER INSECURITY AND GLOBAL PANDEMIC

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Abstract
The prices of most conventional feed ingredients are currently on the high side due to the soaring and competitive demand among humans, industries and animals, farmer/herder crisis, armed banditry and lockdown occasioned by the global pandemic (Covid-19). Biodegradation techniques such as enzymatic supplementation, solid state fermentation with fungi or microbial fermentation have been used to enhance the feed value of poor quality non-conventional ingredients used in livestock feed formulation. Biodegradation of agro industrial wastes and the utilisation of the biodegraded wastes as ingredients in livestock feeding will go a long way in making animal products available and affordable, and thus improve the dwindling animal protein intake among the populace. This review examines the prevalence of feed insecurity, its effects on socioeconomic development in Nigeria and solution to the problem. The research adopts qualitative approach to analysis which relied on secondary sources like journals, textbooks, newspapers and online publications. It is concluded that biodegradation of copiously available agro industrial by products could proffer a solution to the problem of animal feed scarcity/insecurity, which directly enhances (boosts) animal production. The review recommends that governments at all levels work together with universities, agricultural research institutes and ministries of agriculture to designate extension workers to train local farmers on biodegradation of agro wastes in these perilous times.
Keywords: Biodegradation, feed scarcity, insecurity, banditry, global pandemic, agro-industrial by-product.

Introduction

Food scarcity due to insecurity, global pandemic (corona virus pandemic, Covid-19) and subsequent crash in economy due to the global lockdown and several miscalculations of international monetary fund policies guiding the economy have so far brought about untold hardship due to increases in price of commodities nationwide. Animal feed manufacturers, due to the scarcity and subsequent increase in price of commodity, have consequently increased prices of animal feed, leaving the local animal farmers in malaise. Agro-industrial by-products (AIBPs) have, nonetheless, over the years attained great recognition in livestock feeding. AIBs, such as cassava peels, cocoa husks, maize cobs, wheat offal and recently sugarcane scrapings among others, are presently generally used as animal feed. The trend has changed from the situation in which these by-products were considered as wastes; they are now being converted to animal protein for human consumption. Gone also are the days when industrial by-products such as dried brewers grains from the brewing industries, wheat and maize offals from the flour industries and molasses from the sugar industries were considered as pollutants and, therefore, burnt (Iyeghe-Erakpotobor *et al*., 2002). Integration of livestock and AIBPs allow resources to be recycled more effectively in livestock production enterprise. Large quantities of crop residues produced on private, commercial and government farms in Nigeria are not utilized time after time. Some are left to decompose in the field, which may improve soil fertility anyway, but most are burned. O'Donovah (1979) reported that livestock fed with AIBPs exhibited substantial weight gains. The abundant supply of AIBPs at reasonably low prices could increase production and decrease cost of compounded feeds. while not adversely affecting the performance of the animals. However, the lignin content of most AIBPs make the nutrient inaccessible and indigestible. Solid state fermentation (biodegradation), a simple and cheap technique, has been employed in delignification of lignified AIBPs or lignocellulosic materials. The efficacy of biodegradation with fungi depends on the fungus and its enzymes, physical structure of substrate, physiological factors of fermentation and culture, and nutritional conditions. All of these play important roles in controlling lignin degradation and digestibility of fermented substrates (Zadražil, 1986). The safety of feeding biodegraded AIBPs to

livestock has been studied by examining the blood profile of animals fed AIBPs containing diets. Blood serum metabolic profiles are good indicators of the nutritional and health status of animals and have been used for diagnosis and prognosis of diseases as well as understanding if some changes in animals' diet can affect their physiology (Olafadehan, 2011). Results of blood biochemical analysis of animals fed biodegraded AIBPs or crop residues showed uncompromised health (Belewu *et al*., 2006; El–Bordeny *et al*., 2015 and Ochepo *et al*., 2016).

Major causes of animal feed scarcity

1. Farmer/herder crisis
2. Armed banditry
3. Global pandemic effects

Farmer-herder crisis

Prior to 20th century, animal rearing, most especially cattle was prevalent in the Guinea, Sudan and Sahel savannah belts where crop farming was carried out on small scale only during the very brief rainy season. This gave cattle herders access to a vast area of grass land. However, the introduction of irrigated farming in the savannah belts of Nigeria and the increased loss of pasture during dry season have made pasture less available for cattle. The herdsmen had to move southward to the coastal zone where rainy season is extended and the soil holds moisture for long in search of greener pasture and fresh water for their cattle (Ofuoku and Isife, 2009). As the herders migrate southward, where the grass is usually fresh, and often intrude into spaces long claimed or cultivated land by settled farmers, conflicts often result (Olaniyan, *et al*. 2015). This conflict is known to have been present since the onset of agriculture and either increased or decreased in intensity depending on economic, environmental and other factors (Aliyu, 2015). Herdsmen-farmers or herder-farmer conflicts are conflicts occurring between peasant/local farmers or subsistent cultivators and nomadic or transhumant livestock holders. According to Hagmann (2003), there exists differences between 'herder-herder' conflicts and 'farmer-herder' conflicts. He explained that herder-herder conflicts are often conflicts between nomadic or transhumant livestock keepers that arise between receiving groups over their territory's resources and new groups seeking for water and pastures, and sometimes cattle raiding.

In many places, herders have clashed with farmers and their host communities over cattle destruction of crops, farmers' encroachment on grazing reserves and indiscriminate bush burning by nomads which usually cause crop loss (Olaleye *et al*., 2010; Ofem and Inyang, 2014; Adeoye, 2017). The seeming boldness of the perpetrators and mystery surrounding the actual cause have continued to attract mixed feelings/perceptions. The frustration-aggression theory in application to this study explains that the goal or aim of every farmer during planting season is to have bountiful harvest, sell the farm produce and make profits. On the other hand, the herdsmen would seldom want a properly fed and healthy cattle and be able to make profits from sales as well. When any of these expectations are not achieved, either by the herd (cattle) eating up and destroying the farmers' crops or that the farmer encroached on grazing reserves or use water reserved for cattle to irrigate their farms, aggression would be triggered. Furthermore, conflict theory describes land resources (such as farm lands, crops, grass/pasture, fresh water, etc.) are scarce in Nigeria and required by both farmers and herdsmen for sustenance of their various sources of livelihood. Conflict, however, would not only occur between herders and farmers as both survive with another in pursuit of these resources but as either of the groups tries to encroach or exploit another's readily available and long acquired resources.

Armed banditry

The insecurity in the North-West region have caused a negative impact on the utilization of environmental resources (e.g. gold mining), thus influencing the livelihood and development positive prospects in the affected States. The presence of profitable gold deposits in Zamfara State attracted artisanal mining activities, as bandits and a few families turn on it for livelihood sustenance. Nevertheless, the gold is smuggled and traded in the global market constituting an unimaginable loss in revenue for the country's economy. The erstwhile Minister of Mines and Steel Development, Alhaji Abubakar Bawa Bwari, had revealed that between 2016 and 2018, Nigeria lost 353 billion naira from the illicit activities of gold miners and smugglers (Punchngr, 2020). Though artisanal mining has been strongly related to economic gains including informal employment, the poor standards of extraction have resulted in land degradation, contamination of water sources and health

risk. In 2010 and 2013, the State recorded an outbreak of 'lead poisoning' epidemic due to unlawful mining activities resulting in a death toll of 734 children below the ages of 5 years old (All Africa.com, 2013). Given the fact that farming is the mainstay of the local economies, the disruption in farming due to bandit attacks affect agricultural productivity with serious implications for food security. Majority of the farming communities were forced to relinquish their farms especially in areas close to the forest areas, as bandits use these locations to attack communities. Few farmers who stayed behind were subjected to taxation by the bandits before accessing their farms whether planting or harvesting (Punchngr, 2020). About 30% of arable land in Kaduna State was abandoned by affected communities, while farming activities in Zamfara and Katsina States were restricted to few areas thus resulting in decreased food production by 60% (WANEP, 2019). In Kebbi State, over 350 rice farmers were struck with farmlands abandoned due to bandit attacks (Punchngr, 2020). Similarly, grazing activities of herders were also affected due to the insecurity.

Global pandemic effect on agriculture and animal production

The livestock sector greatly contributes in the achievement of optimum protein supply, economic returns and sustainable environment in most developing countries and would require continuous search for alternative methods that are environmentally friendly, cost effective and in less demand as direct food resource for humans. Animal production in the tropics have been hindered by a handful of incessant challenges resulting in both decrease in production and supply to final consumer.

Agriculture / farming systems in the country are endangered with a handful of problems such as economic and environmental challenges as a result of the pandemic of Covid-19. But of great concern is the effect on crop production and its quality. This is because due to the Covid-19 pandemic, soil fertility, harvest time and basic farm inputs, such as supply of fertilizers, pesticides, etc., are negatively affected. Some crops were abandoned on the farms and harvesting was delayed. Delaying the harvest process of forages can reduce the digestibility and crude protein (Seleiman *et al*., 2020), thus lowering livestock productivity. As a result of the Covid-19 pandemic in northern and middle belt of Nigeria, which are the hub of food production, labour shortage delay some of the agricultural practices such as sowing and harvesting time, fertilizer application, irrigation and weed control. Similarly, outbreak of Coronavirus (Covid-19) impacts cynically poorly on farm inputs distribution as there is no readily available free movement of commercial transport to convey agricultural raw materials from point of sales to regions where they are needed in the entire nation and northern part in particular. In general, Covid-19 affects the agricultural sector adversely in that, it weakens output-growth through obtaining factor inputs as spending on off-shore inputs, which compels a large portion of aggregate inputs that has to be reduced significantly. For instance, in the agricultural sector, there was a reduction in farm-to-market distribution of agricultural products (Obayori *et al*., 2020), thereby leading to food dearth and hence increase in the prices of agricultural products.

Biodegradation of AIBPs using white rot fungi as a solution to the problem of feed scarcity

Zadražil *et al*. (1999) defined biodegradation or solid state fermentation (SSF) as a procedure in which solid substrates are broken down by known pure or mixed cultures of microorganisms (mainly fungi which can grow on and through the substrate) under controlled conditions, with the aim of producing a high quality standardized products (different from the composted material). SSF is a polyfactorial procedure in which the fungus and its enzymes, physical structure of substrate, physiological factors of fermentation and culture and nutritional conditions play an important role in controlling lignin degradation and digestibility of fermented substrate (Zadražil, 1986). The radical improvement of agro-industrial activities over the last few years has led to the accumulation of a large quantity of lignocellulosic residues all over the world, resulting in abundant availability of non-conventional feed resources for livestock. Though AIBs and crop residues are mostly fibrous, biodegradation can used to upgrade their nutritional quality. Besides, biodegraded feed materials can be preserved for a long period without deterioration and utilised during the lean period when fodder or conventional ingredients are scarce and expensive. Therefore, proper harnessing, biodegradation and preservation of lignocellulosic AIBPs or crop residues can be used to ameliorate the problem of feed scarcity due to insecurity and current global pandemic (Covid 19). Previous assays (Belewu *et al*., 2006; El–Bordeny *et al*., 2015; Ochepo *et al*., 2016 and Anaso, 2020) on the health implication of feeding biodegraded AIBPs/crop residues containing diets indicate unaffected health status of livestock fed such diets. The authors also reported enhanced performance of livestock fed biodegraded AIBPs relative to those fed non-biodegraded AIBPs.

Conclusion

The problem of feed scarcity for livestock due to incessant farmer-herder clashes, armed banditry and current global pandemic (Covid-19) can be abated by harnessing, biodegrading and feeding copiously available AIBPs/crop residues in Nigeria. Biodegradation and preservation of AIBPs can guarantee all-year round feed availability for livestock and thus curb the menace associated with transhumant livestock production system. Empirical evidences of feeding biodegraded AIBPs either as energy or protein source in the diets of livestock to improve their productivity without compromising their health abound.

Recommendations

Government at all levels should provide facilities for universities via the faculty of agriculture, agricultural research institutes and ministries of agriculture for further research and training of agricultural extension workers who in turn should teach local farmers on the biodegradation procedures which is cheap and simple, thereby boosting production levels. Governments at all levels should also prioritise legislations outlawing open grazing of cattle, while encouraging herders to establish ranches for their cattle where biodegraded agro industrial wastes can be utilised in animals diet to maximize productivity.

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