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A REVIEW ON THE EFFECT OF CASSAVA PEEL MEAL IN LIVESTOCK PRODUCTION

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ABSTRACT

Cassava peels are abundant agro-industrial by-products generated during cassava processing particularly in major producing countries such as Nigeria. Despite its availability, their utilization in livestock feeding is constrained by low protein content, poor digestibility and the presence of anti-nutritional factors such as cyanogenic glycosides and phytate. This review evaluates the potential of cassava peels as an alternative energy source in livestock diets, focusing on its nutritional characteristics, limitations, and methods for improvement. Processing techniques, especially fermentation, have been shown to reduce toxic compounds and enhance nutrient availability. Evidence from various studies indicates that properly processed cassava peels can partially or completely replace conventional feed ingredients like maize in poultry, ruminant, rabbit and swine diets without adverse effects on performance. Their inclusion also contributes to reduced feed costs and improved sustainability through waste utilization. However, further research is therefore required to evaluate long-term safety, particularly the accumulation of residual hydrogen cyanide in animal tissues.

Keywords: Cassava peels, livestock nutrition, Fermentation, Anti-nutritional factors, Feed cost reduction

INTRODUCTION

Feed constitutes the most expensive component of semi-intensive livestock production, accounting for 70-80% of total costs in livestock production. Consequently, considerable efforts have been directed toward minimizing feeding costs. As part of strategies to enhance sustainability in livestock production, costly conventional feed ingredients are increasingly being replaced with cheaper and more readily available agro-industrial by-products. These by-products include materials such as cassava peels, rice straw, maize stover and pulp. However, they are typically characterized by high levels of cellulose and hemicellulose-complex carbohydrates that limit their nutritional value (Van Kuijk et al., 2015).

The utilization of agro-industrial by-products in monogastric animal nutrition is often constrained by poor digestibility and reduced feed intake, resulting in low overall nutritional efficiency (Obado and Badifu, 2024). To address these limitations, animal nutritionists have explored various methods to enhance the feeding value of such materials. These methods include physical treatments (grinding, drying, soaking and pelleting), chemical treatments (alkaline, acidic and oxidative processing) and biological approaches such as fermentation using microorganisms including yeast and fungi, as well as enzyme supplementation (Sarnklong et al., 2010).

Cassava (Manihot esculenta) is a widely cultivated tropical crop that thrives in marginal and arid soils (Egbune et al., 2022). Nigeria is currently the largest producer of cassava globally, with an annual production of approximately 59.49 million metric tons (MMT), representing about 20.4% of global output. Thailand ranks second with a production of 31.7 MMT (Nyerhovwo et al., 2023). Additionally, Nigeria contributes approximately 59.5% of Africa's total cassava production, estimated at 139.6 MMT (Oghenejoboh et al., 2021; Egbune and Tonukari, 2023).

Large amounts of cassava peels are usually generated from cassava processing (Adegbehingbe and Adeleke, 2021) and are discarded when cassava is processed into various food products (Ozoegwu *et al*., 2017). During cassava processing, the roots are peeled to remove two outer layers: a thin brown outer covering and a thicker inner parenchymatous layer (Souto et al., 2016). This process generates substantial quantities of cassava peels, which constitute approximately 10–12% of the total dry matter of the root (Maraphum et al., 2022). In Nigeria alone, about 9 million tonnes of cassava peels are produced annually (Ajala et al., 2018). Despite this abundance, a significant proportion of these residues is improperly disposed of, contributing to environmental pollution and waste accumulation at processing sites (Adelekan and Bamgboye, 2009).

Rather than allowing cassava peels to remain as environmental waste, they can be effectively utilized as low-cost raw materials for various industrial applications, including animal feed production (Nwabueze and Otunwa, 2006). Furthermore, cassava peels have considerable potential as substrates for the production of value-added biotechnological products such as bioethanol, biogas, citric acid and other biochemicals when properly processed (Nyerhovwo et al., 2023).

Nutritionally, cassava peels contain relatively low crude protein (less than 6%) but higher levels compared to other tuber components (Tewe, 1984). However, their utilization is limited by the presence of anti-nutritional factors, notably cyanogenic glycosides, phytates (up to 1% DM) and hydrocyanic acid (HCN), which are particularly toxic to monogastric animals (Ubalua, 2007; Salami and Odunsi, 2003). Fresh cassava peels are also highly perishable, further complicating their use.

Processing techniques such as fermentation and ensiling have been shown to significantly reduce cyanogenic compounds and phytate levels (to approximately 0.7%), thereby improving their safety and nutritional value (Unigwe et al., 2017). Properly processed cassava peels can achieve HCN levels below 50 mg/kg, which is considered safe for animal consumption. Therefore, the effective utilization of cassava peels through appropriate processing methods presents a viable opportunity to convert this abundant waste into an economical energy source for livestock feed.

The increasing production and consumption of cassava inevitably lead to higher volumes of cassava peel waste. These residues are widely available and face minimal competition with human food resources. However, large quantities are often discarded, particularly during the rainy season when drying to safe moisture levels for storage becomes challenging (Oladimeji et al., 2022). This underscores the need for efficient processing and utilization strategies to maximize their potential in livestock nutrition.

Cyanogenic Properties of Cassava Peel

Cassava contains two major cyanogenic glycosides: linamarin (2-β-D-glucopyranosyloxy isobutyronitrile), which constitutes approximately 80% of the total glycosides, and lotaustralin (methylbutyronitrile), accounting for the remaining 20%. Upon tissue disruption, endogenous enzymes hydrolyze these compounds, leading to the release of hydrogen cyanide (HCN), a highly toxic compound to animals. The concentration of hydrogen cyanide in cassava varies widely depending on several factors, including cultivar type, environmental conditions, plant age, harvesting frequency (in the case of foliage), and the specific plant part being utilized. A continuous variation in HCN content exists among cassava varieties (Peroni et al., 2007), which are generally classified into two categories: bitter and sweet varieties. Bitter cassava varieties contain relatively high levels of cyanogenic compounds, with roots containing approximately 0.02–0.03% HCN on a dry matter basis and leaves containing up to 0.2% HCN on a fresh weight basis (Murugesrawi et al., 2006). Due to these elevated levels, bitter varieties require adequate processing before being used as animal feed. In contrast, sweet cassava varieties contain lower cyanide concentrations, typically less than 0.01% HCN in roots (dry matter basis) and about 0.1% in leaves (dry matter basis), making them relatively safer and in some cases, suitable for direct feeding (Murugesrawi et al., 2006). Most commercially cultivated cassava varieties fall within this category. Although bitter cassava varieties are often characterized by longer and thicker roots compared to sweet varieties, there is no simple or reliable visual method for determining cyanide content. Nevertheless, hydrogen cyanide can be significantly reduced through appropriate processing methods. Properly processed cassava peels typically contain HCN levels below 50 mg/kg, which is considered safe for animal consumption (Nwokoro et al., 2005). Despite this, cases of cyanide toxicity have been reported. For instance, an outbreak of acute HCN poisoning occurred in an intensively managed pig farm in Nigeria, where more than half of the herd died within a few hours after consuming boiled, overripe cassava peels derived from a bitter variety. Emergency treatment involving antibiotics and palm oil administration reportedly helped to save some of the affected animals (Sackey, 2002). This highlights the critical importance of proper processing and quality control when incorporating cassava peels into livestock diets.

Phytate Properties of Cassava Peel

Cassava peels are characterized by a relatively high phytate content, which may reach up to 1% on a dry matter basis. Phytate (myo-inositol hexakisphosphate) is a well-known anti-nutritional factor that binds essential minerals, particularly phosphorus, thereby reducing their bioavailability in monogastric animals (Ubalua, 2007). As a result, a significant proportion of the phosphorus present in cassava peels remains biologically unavailable, leading to poor mineral utilization and potentially affecting growth and bone development in livestock.

In addition to phosphorus, phytate can also chelate other important minerals such as calcium, zinc, and iron, further compromising the nutritional quality of cassava-based diets. Monogastric animals, including poultry and pigs, lack sufficient endogenous phytase enzymes required to effectively hydrolyze phytate, which exacerbates the problem of nutrient unavailability.

Processing methods, particularly fermentation, have been shown to reduce the phytate content of cassava peels. During fermentation, microbial activity produces phytase enzymes that degrade phytate into simpler, more bioavailable forms. This process can reduce phytate levels from approximately 1% to about 0.7% on a dry matter basis (Oboh, 2006). Although this reduction is moderate, it significantly improves mineral availability and enhances the overall feeding value of cassava peels.

Therefore, appropriate processing techniques, especially fermentation, play a crucial role in mitigating the anti-nutritional effects of phytate and improving the suitability of cassava peels as a feed ingredient in monogastric animal nutrition.

Effects on Livestock Performance

Poultry

Considerable efforts have been made to improve the nutritional quality of cassava-based products and enhance their utilization in poultry diets through various processing techniques, with promising outcomes. For instance, high-quality cassava peel meal has been reported to replace maize at inclusion levels of up to 200 kg per ton of feed without compromising bird performance (Onabanjo et al., 2024). Such substitution not only maintains productive performance but also offers economic advantages by reducing feed cost per kilogram and cost per unit weight gain, thereby contributing to significant savings in maize usage, which is also a major staple for human consumption (Adekeye et al., 2021).

Similarly, studies have demonstrated that cassava peel meal and cassava leaf meal can partially replace maize and soybean meal, respectively, in broiler diets without adverse effects on haematological and serum biochemical parameters (Makanju et al., 2021). Adedokun (2023) reported that broiler chickens fed diets containing Umucass 36 cassava root meal showed no deleterious effects on their haematological parameters or serum biochemical indices. In addition, inclusion levels ranging from 25% to 75% cassava peel meal have been reported to support satisfactory growth performance in broilers without significant negative effects, while also improving economic returns due to reduced production costs (Egbewande et al., 2021).

Despite these positive findings, the presence of cyanogenic glycosides in inadequately processed cassava products remains a major concern. These compounds can interfere with calcium metabolism (Ogbuewu and Mbajiorgu, 2023), which is critical for eggshell formation in laying birds. Consequently, insufficient detoxification of cassava-based feeds may lead to reductions in egg production, egg weight, and egg quality parameters such as albumen and yolk indices (Onyango et al., 2021).

However, some studies have shown that properly processed cassava products can be safely included in layer diets. For example, inclusion of up to 25% whole cassava meal has been reported to have no detrimental effects on both internal and external egg quality traits, including shell thickness, yolk proportion, and albumen index (Kyawt et al., 2014). In contrast, other researchers have observed negative effects, such as reduced egg weight, poorer yolk coloration, and decreased laying rate at inclusion levels of around 20% cassava peel or root meal (Aderemi et al., 2012; Ezihe and Uchendu, 2017).

These conflicting findings highlight the variability in responses to cassava-based diets in poultry, which may be attributed to differences in processing methods, inclusion levels, cassava variety, and overall diet formulation. Consequently, the optimal inclusion level and efficacy of cassava products particularly in specialized poultry such as quails remain inconclusive, thereby necessitating further research to establish standardized recommendations.

Ruminants

To enhance the nutritional value of agro-industrial by-products, strategies such as microbial fermentation have been widely explored. This approach involves enriching low-protein feed resources using microorganisms, including yeast (Saccharomyces cerevisiae) and mixed microbial cultures commonly referred to as effective microorganisms (EM) (Oboh et al., 2005; Sengxayalth and Preston, 2017). Fermentation has been shown to significantly improve the crude protein content of cassava peels; for instance, yeast fermentation increased protein levels from 2.4% to 14.1% (Antai and Mbogo, 1994).

In ruminant nutrition, fermented cassava peels have demonstrated considerable potential as a substitute for conventional feed ingredients. For example, dried fermented cassava peel has been successfully used to replace up to 30% of wheat bran in the concentrate diets of lactating goats without adverse effects (Suranindyah and Astuti, 2012). Furthermore, cassava peel combined with cassava and sweet potato forage has been reported to enhance rumen fermentation characteristics, including increased gas production, short-chain fatty acid concentration and organic matter digestibility (Kalio, 2019).

Similarly, effective microorganism-fermented cassava peel has been shown to replace up to 50% of concentrate feed without negatively affecting feed intake, nutrient digestibility, rumen fermentation, or overall growth performance (Pongsatorn, 2023). This substitution also contributes to a reduction in feed cost per unit weight gain by as much as 32%. These findings highlight the potential of properly processed cassava peels as a cost-effective and nutritionally enhanced feed resource for ruminant production system

Rabbit

Rabbits possess a unique digestive system that enables efficient utilization of fibrous feed materials, largely due to their well-developed caecum and the practice of coprophagy, which enhances nutrient recycling and digestion (Iwegbu et al., 2023). This physiological adaptation makes rabbits particularly suitable for the utilization of agro-industrial by-products such as cassava peel meal.

Studies have shown that replacing maize with sun-dried cassava peel meal at inclusion levels of 25–50% does not adversely affect rabbit performance (Evans et al., 2023). Additionally, cassava peel meal can be included in growing rabbit diets at levels up to 350 g/kg, provided that the diets are adequately supplemented. Specifically, supplementation with methionine at levels approximately 32.53% above the standard requirement, along with 5.5 g/kg of multi-enzyme additives, has been reported to prevent negative effects on amino acid digestibility, blood parameters, serum indices, and antioxidant status (Olugbenga, 2020).

Further research indicates that combinations of sun-dried cassava peel and maize can effectively replace conventional maize in rabbit diets without compromising growth performance (Akindele et al., 2025). Complete replacement of dietary maize with fermented cassava peel meal enhanced growth performance and meat output without any detrimental effects (Oyewole, et al., 2025). However, the use of cassava peel meal remains economically advantageous due to its low cost and limited competition with human food resources.

In addition to growth performance, cassava peel meal has shown positive effects on reproductive parameters. For instance, rabbits fed diets containing 40% cassava peel meal exhibited improved semen quality, including higher sperm concentration, viability and motility, which are critical factors for successful reproduction (Oyibo et al., 2025). These findings suggest that cassava peel meal can serve as a viable alternative energy source in rabbit nutrition while also enhancing reproductive performance when properly formulated.

Swine

The utilization of cassava-based feed resources in pig production has been widely investigated, particularly in cassava-producing regions of sub-Saharan Africa. The inclusion of cassava products in pig diets offers a sustainable alternative to conventional cereal grains, thereby reducing feed costs and ensuring a more consistent and year-round supply of energy for livestock.

Studies have demonstrated that cassava peel-leaf blends can effectively replace maize in pig diets up to 50% without adversely affecting growth performance, haematological indices or serum biochemical parameters, regardless of the processing method employed (Gabriel et al., 2023). It has been reported that such blends can replace maize at inclusion levels of up to 50% without compromising animal health or productivity.

In a related study, the incorporation of dietary sludge in combination with processed cassava peel meal was found to positively influence the growth performance of pigs (Obongekpe and Ekpo, 2022). The authors recommended the inclusion of processed cassava peel meal supplemented with dietary sludge at levels up to 85%, as this significantly improved daily feed intake and overall productivity.

These findings indicate that properly processed cassava peel meal, either alone or in combination with other feed resources, can serve as an economical and effective alternative energy source in pig nutrition.

CONCLUSION

Cassava peels, traditionally considered agricultural waste, possess significant potential as an energy source in livestock feed when properly formulated and processed to reduce hydrogen cyanide and phytate levels. Its inclusion in animal diets can partially or fully replace conventional energy ingredients, thereby contributing to cost-effective feed formulation. This review highlights the importance of re-evaluating cassava peels as a valuable feed resource rather than a by-product. Further studies are recommended to assess the accumulation of residual hydrogen cyanide in animal tissues such as the liver, lungs and muscles.

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