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Research Application Summary

A review of the nutritive value and utilisation of quality protein maize in indigenous chicken production

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Abstract

Indigenous chickens play an important role in African rural households particularly in improving their livelihoods. However, indigenous chicken production is characterised by low productivity due to poor management practises, particularly poor nutrition among other factors. Nutritional research into conventional, locally available and cheap feed stuffs is an imperative in enhancing the productivity of Indigenous chickens among smallholder farmers in Zimbabwe. One such ingredient with potential is Quality Protein Maize. It is generally observed that Quality Protein Maize contains opaque-2 gene resulting in maize with elevated levels of tryptophan and lysine. Research into the interactions of Quality Protein Maize and growth performance and carcass characteristics of Indigenous chickens has become inevitable as preconditions for increasing chicken productivity particularly among small holder farmers. Addressing these preconditions is a precursor to sustainable indigenous chicken production among rural farmers. These issues are discussed in this paper.

Keywords: Carcass quality, indigenous chicken, Quality Protein Maize

Resumé

Les poulets locaux jouent un rôle important dans les ménages ruraux africains, notamment dans l'amélioration de leurs moyens de subsistance. Cependant, la production de poulet local se caractérise par une faible productivité en raison de mauvaises pratiques de gestion, surtout une mauvaise nutrition parmi d'autres facteurs. La recherche nutritionnelle sur les aliments traditionnels, disponibles localement et peu coûteux est un impératif pour améliorer la productivité des poulets locaux chez les petits agriculteurs au Zimbabwe. Un tel ingrédient potentiel est le maïs riche en protéine. Il est généralement observé que le maïs riche en protéine contient le gène opaque-2 donnant lieu à du maïs ayant des teneurs élevés en tryptophane et lysine. La recherche sur les interactions entre le maïs riche en protéine, la performance de croissance et les caractéristiques de carcasse des poulets locaux est devenue inévitable comme déterminants de l'augmentation de la productivité du poulet, en particulier chez les petits agriculteurs. La prise en compte de ces déterminants constitue un précurseur de la production durable de poulets locaux chez les agriculteurs ruraux. Ces questions sont examinées dans le présent document.

Mots-clés: Qualité de la carcasse, poulet local, Maïs riche en protéine

Background

Indigenous chickens are an important contribution to the livelihoods of small holder families in Africa (Muchadey*i et al*., 2007). In Zimbabwe 90% of the smallholder farmers rear indigenous chickens. These indigenous chickens contribute significantly to the livelihoods of the smallholder farmers through provision of cheap quality protein in the form of meat and eggs (King Ori *et al.*, 2010). However, they are characterised by low productivity attributed to slow growth rates, low mature weights, low egg production and high mortality due to poor nutrition (Mapiye *et al.*, 2008). This implies that their contribution to the household protein food security may not be fully realized without appropriate feeding interventions. These birds are raised under scavenging conditions, where they scavenge for their own food and are supplemented with whatever is available in the homestead (King Ori *et al* ., 2010).

Research has shown that in the case of indigenous chickens the protein and energy intake under scavenging conditions is below nutritional requirements of the chicken which causes protein deficiency and reduces growth (Raphulu *et al.,* 2015). To improve productivity of Indigenous chickens, the feed resource base of Indigenous chickens must be improved. This could be achieved through the use of nutritionally balanced feedstuffs. One such ingredient with potential is Quality Protein Maize. The beneficial effects of Quality Protein Maize have been demonstrated when used as a component of rations in indigenous layer chickens, weaner pigs and broilers (Prabowo *et al*., 2010; Mpofu *et al.*, 2012). Improving indigenous chicken productivity through the use of QPM will be a low cost way to improve protein nutrition that will diversify and increase income levels of rural population. Hence the rationale for this study.

Literature Review

Types of Indigenous Chickens in Zimbabwe

In Zimbabwe, indigenous chickens have not been genetically classified into specific breeds, however different ecotypes exists (Assan, 2015). Generally in Zimbabwe like in other African countries ecotypes have been identified phenotypically and five different ecotypes have been found, and include Naked neck, Spotted, Black Australop, Rumples araucana Americana and Barred Rocks (Khombe, 2012). Generally these ecotypes exhibit the following characteristics, good mothering ability, resistance to diseases and average egg production of 15- 21 eggs per breeding cycle. Males weigh 2.7 kg, 2.5, 1.9 and 2.3 kg for the black australop, rumples araucana Americana, spotted and naked neck ecotypes, respectively. On the other hand females weigh 1.9, 2.1, 1.5 and 2.0 kg for the australop, rumples araucana Americana, spotted and Naked neck ecotypes, respectively (Khombe, 2012). However there is little documented research that has been done to evaluate the performance of the different ecotypes under different management regimes.

Indigenous Chicken Production systems in Zimbabwe

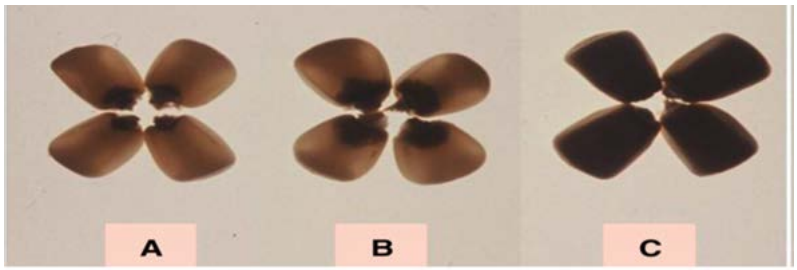
In Zimbabwe, indigenous chickens are raised under the extensive production system which are dominated by indigenous poultry breeds (Khobondo, 2015). The number of Indigenous chickens in Zimbabwe is estimated to be between 15 and 30 million, the estimate being based on about one million communal farmers each keeping an average of 20 birds (Assan, 2015). Although village chicken are characterised by low productivity of 30-80 small eggs per hen per year, high chick mortality rates and low body weights, they are hardy, i.e., tolerant to diseases and used to poor nutrition (Mapiye, 2008).

Production constraints of Indigenous chickens

Despite the importance of Indigenous chickens to livelihoods of small holder farmers, productivity still remains low. Mapiye *et al.* (2008) and King Ori *et al.* (2010) attribute the low productivity to poor management practises particularly nutrition, disease prevalence and housing. The extensive system under which Indigenous chickens are raised provide suboptimal nutrients for production. Scavenged material consists of insects, food wastes, green grass, leafy vegetables and grains. Analysis of the scavenged feed has shown that the scavenging system alone is not adequate to support production (Khobondo, 2015). Protein supply has been found to be limiting especially during the drier months of the year, whereas energy is critical at all times, particularly during the rainy season. Farmers in Zimbabwe know the benefits of supplementary feeding (Peterson, 2002), and 67% of farmers in Rushinga district practised supplementary feeding. However the quality and quantity of the supplementary feed given to indigenous chickens is not clear. The birds are often fed with any available feed, which is not measured and given indiscriminately among different age groups (Mapiye *et al.*, 2008). It is important for farmers to learn how to formulate balanced rations. This is specifically so since research has shown that even though indigenous chicken have a lower genetic potential, providing a balanced diet will increase their growth rate (King Ori *et al.*, 2010).

Cultivation practises and utilisation of Quality Protein Maize

In sub-Saharan Africa 30 million hectares are under maize production (Machida *et al.,* 2014). It is the main staple food and forms an important constituent in the feed Industry (Groote *et al.,* 2010). Quality Protein Maize refers to maize homozygous for the opaque 2 allele, with elevated levels of lysine and tryptophan (Krivanek, 2007). It looks and tastes like normal maize, but can be differentiated from normal maize through the use of Light tables (Krivanek. 2007). Switching from normal maize to QPM provides a more balanced protein source relative to normal maize, without sacrificing energy, yield, and micronutrients or changing native food supply systems The figure below shows the phenotypic differences of normal maize and Quality Protein Maize.



Back-lit maize kernels illustrating the phenotypic differences of opaque-2 mutation. Normal maize (A); QPM (B); opaque-2 maize without modification of agronomic characteristics (C).

Despite the nutritional importance of Quality Protein Maize, in Zimbabwe farmers are not aware of its existence and importance, but the germplasm is available (Machida *et al.*, 2014). QPM varieties have the potential to perform better and retain good protein quality under a range of nitrogen levels and hence the potential to suit well in different farming systems. There is therefore need to evaluate the effect of Quality Protein Maize in livestock diets so as to facilitate its adoption as both a feed and food.

The use of Quality Protein Maize in Poultry

The nutritional value of normal maize to monogastric animals is poor as it is deficient in essential amino acids such as lysine, tryptophan and methionine, due to a relatively higher proportion of prolamines in maize storage proteins which are essentially devoid of lysine and tryptophan (Nuss *et al*., 2010). Lysine, tryptophan and threonine are the limiting amino acids to monogastrics (Panda *et.al.,* 2010). To curb the deficiency of essential amino acids in poultry diets, Quality Protein Maize can be used. Quality protein maize has a lysine content of (0.48%) and tryptophan (0.11%) compared to 0.23% lysine and 0.05% tryptophan content in normal maize (Krivanek, 2007). The beneficial effects of quality protein maize have been demonstrated when it was used successfully as a component of rations in indigenous layer chickens (Prabowo *et al.,* 2010), weaner pigs (Mpofu *et al.*, 2012). and broilers (Panda *et al*., 2011). In each case, increases in growth performance, feed economy, carcass yield and mature weights were observed.

The Use of Quality Protein Maize in Indigenous chickens

Smallholder farmers have been using some home-grown and home-processed feeds in order to alleviate feed limitations in indigenous chicken production. However, there is a paucity of information on systematic research on the nutritive value and levels of inclusion of Quality Protein Maize in chicken diets. The nutritive value of a feed is a function of the feed intake, the efficiency of extraction of nutrients from the

feed during digestion and the efficiency of utilisation of the extracted nutrients for growth (Mupangwa *et al.*, 2000) or production of products such as eggs. There is therefore need for sustained assessment of the nutritive value of conventional feeds incorporating Quality Protein Maize in order to find out the best ways of utilising it as a protein source in diets of indigenous chickens.

Conclusion

Indigenous chickens in Zimbabwe are raised under poor management regimes hence their full genetic potential for fertility and growth is not adequately recognised. Research has shown that supplementary feeding increases growth rate. There is need to evaluate nutritionally cheap and locally available feedstuffs such as Quality Protein Maize so as to improve productivity in Indigenous chickens.

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