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Research Application Summary

Hydrolyzed *Prosopis juliflora* pods substitute 50% maize in indigenous chicken layers feed

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Abstract

Cereals are a major source of human food, hence their use as livestock feed causes competition and shortage leading to increased prices. Consequently, it is essential to explore alternative feed resources that are locally available and affordable. *Prosopis juliflora* pods is among the alternative feed resources identified in Kenya. It is locally referred to as 'Mathenge'. Crude fiber is high in Prosopis juliflora pods. The soluble fiber increases the viscosity of the intestinal digesta therefore making it difficult for the chyme to mix thoroughly with enzymes for purpose of digestion and absorption of nutrients. This is because of lack of indigenous non starch hydrolyzing enzymes in the gut of poultry. Non convectional feed resources like *Prosopis juliflora* pods can be used to feed livestock and reduce competition with humans on cereals and hence ensure a food secure society. Utilization of *Prosopis juliflora* pods by making poultry feeds will reduce the invasion by the tree in arid and semi-arid areas. The objectives were to determine the nutrient composition of 'mathenge' compared to maize with emphasis on fiber, minerals and energy and also look at the feed intake and egg production of feeds compounded with up to 50% 'mathenge' substituting maize. Proximate analysis and gross energy determination was done at Egerton University while minerals were determined at Kenya Agricultural and Livestock Research Organization laboratory at Njoro. The metabolizable energy and crude fiber was 11.34 MJ/kg DM and 3.52 for maize and 15.52 Mj/kg DM and 22.29 for *Prosopis juliflora* pods. Feed containing 0, 20, 30, 40, and 50% *Prosopis juliflora* pods substituting maize were fed to indigenous layer for 12 weeks. Results indicated that the increased inclusion of *Prosopis juliflora*, up to 50% of maize was beneficial in terms of egg and meat production.

Key words: Crude fiber, Mathenge, metabolizable energy, Non convectional feed resources, proximate analysis, *Prosopis juliflora*

Résumé

Les céréales demeurent une source importante de nourriture pour l'humanité, d'où leur utilisation comme aliment du bétail provoque une pénurie entraînant une augmentation des prix. Par conséquent, il est essentiel d'explorer des ressources alimentaires alternatives localement disponibles et abordables. Les gousses de *Prosopis juliflora* font partie des ressources alternatives d'alimentation identifiées au Kenya. Elles sont localement appelées «Mathenge», et très riches en fibre. La fibre

soluble augmente la viscosité du system intestinal, ce qui rend difficile pour le chyme de bien se mélanger avec les enzymes à des fins de digestion et d'absorption des nutriments, ceci étant dû au manque d'enzymes hydrolysantes non amylacées indigènes dans l'intestin des volailles. Les gousses de *Prosopis juliflora* peuvent être utilisées pour nourrir le bétail et réduire la concurrence avec les humains sur les céréales et assurer ainsi une sécurité alimentaire. L'utilisation des gousses de *Prosopis juliflora* en préparant des aliments pour volaille réduira aussi son invasion dans les zones arides et semi-arides. Les objectifs de cette étude étaient de déterminer la composition nutritive du «mathenge» par rapport au maïs en terme de fibres, minéraux et énergie, ainsi que sur la consommation d'aliments et la production d'œufs d'aliments composés avec jusqu'à 50% de «mathenge» substituant le maïs. L'analyse proximale et la détermination de l'énergie brute ont été faites à l'Université d'Egerton tandis que les analyses minérales ont été faites au laboratoire de l'Organisation de recherche agricole et d'élevage du Kenya à Njoro. L'énergie métabolisable et les fibres brutes étaient de 11,34 MJ / kg de MS et de 3,52 pour le maïs et de 15,52 Mj / kg de DM et de 22,29 pour les gousses de Prosopis juliflora. Les aliments contenant 0, 20, 30, 40 et 50% de gousses de Prosopis juliflora remplaçant le maïs ont été utilisés pour nourrir des pondeuses pendant deux semaines. Les résultats ont indiqué que l'inclusion accrue de *Prosopis juliflora*, jusqu'à 50% du maïs, était bénéfique en termes de production d'oeufs et de viande.

Mots clés: fibre brute, Mathenge, énergie métabolisable, ressources alimentaires non conventionnelles, analyse immédiate, *Prosopis juliflora*

Introduction

The current world population of 7.3 billion is expected to reach 8.5 billion by 2030, 9.7 billion in 2050 and 11.2 billion in 2100 (UN, 2015). Currently there are 1.2 billion people in Africa, more than five times the population in 1950. By 2050, Africa's population will double to 2.4 billion, eventually reaching 4.2 billion by the end of the century just about the entire world population in 1977 (UNICEF, 2014). According to UN projections, Kenya's population will grow by around one million per year over the next forty years and will reach about 85 million by 2050 (UN, 2010). This makes agriculture a very crucial part of any economy in order to have a food secure world. The estimated standing populations was 1.43 billion cattle, 1.87 billion sheep and goats, 0.98 billion pigs, and 19.60 billion chicken (Robinson *et al.,* 2014). This increases the competition between human beings and livestock for food especially for cereals. In August 2009, Kenya had a population of 17.5 million cattle, 27.7 million goats, 17.1 million sheep, 334.6 thousand pigs, 2.9 million camels, 1.8 million donkeys, 31.8 million chicken out of which 25.7 million were indigenous and 6.1 million were commercial type (KNBS, 2009).

The supply of adequate, good quality and cost effective livestock feeds is a major challenge in Kenya. This is because of the reliance on cereals and agro-industrial by-products as livestock feed ingredients whose availability is dependent on rainfall. Cereals are major sources of human food hence when used as livestock feed this causes competition and

increased prices. It is therefore essential to explore alternative feed ingredients. These include diverse non-conventional feeds, such as products from trees (Odero *et al.,* 2015). Such feeds are not effectively utilized in Kenya due to lack of information on their nutritive values which is useful in determining their feed inclusion levels (Donkoh and Attoh-Kotoku, 2009). *Prosopis juliflora* named 'Mathenge' in Kenya, is widely available in the arid and semi- arid lands of Kenya. *Prosopis juliflora* pods have been incorporated into feeds for cattle, sheep, camel, buffalo, rabbits, poultry and rats, especially in South America, parts of Africa and India (Sawal *et al.,* 2004).

Chicken are the most abundant and widely kept livestock in the world (Moreki *et al.,* 2010). Indigenous chicken (*Gallus domesticus*) are widely distributed in rural and peri-urban areas where they play an important role in income generation and food production (Moreki *et al.,* 2010). Globally, indigenous chicken produce 30% of all the white meat consumed (FAO, 2012). Moreover, poultry will account for about 40% of the global increase in demand for meat by the year 2020, showing a shift in taste from red to white meat (FAO, 2011). In Africa , over 70% of the poultry population is made up of indegenous chicken (FAO, 2011). Poultry production in Kenya is an important source of livelihood for small scale farmers who produce 80% of the national poultry production (MoALF, 2011). Compared to other livestock species, indigenous chicken rearing remains attractive to poor households because the indegenous chicken are hardy, adapt well to the rural environment, require less startup capital and have low maintenance costs. They are a cheap source of animal protein for financially unstable households. Poultry sub sector creates employment and promotes overall economic development.

The presence of anti-nutritive factors like high fiber and phytic acid limit *Prosopis juliflora* digestion and utilization. Biotechnologies like use of enzymes can be used to improve *P. juliflora* utilization and may increase inclusion levels beyond 20% (Odero *et al.*, 2015) and improve utilization as a result of improved digestion. Improvement as a result of use of biotechnology would mitigate the food insecurity problem for poultry and consequently help alleviate hunger through increased meat and eggs production. This study aimed at determining the effects of non-starch polysaccharides hydrolyzing enzymes inclusion in mature milled *Prosopis juliflora* pods based diets fed to indigenous chicken in terms of feed intake and egg production.

Materials and methods

The proximate composition and gross energy of feed ingredients was determined at the Animal Nutrition Laboratory in Egerton University. The standard procedure of the Association of Official Analytical Chemists (AOAC, 1990) for proximate analysis was used. The bomb calorimeter e2k was used for gross energy determination. Samples of *Prosopis juliflora* pods were taken to the Kenya Agricultural and Livestock Research Organization laboratory at Njoro for mineral determination. Evonik Industries Company based in Germany did amino acid profiling for *Prosopis juliflora* pods. The experiments were conducted at Tatton Agricultural Park, Egerton University. A total of 45 Kenbro layers aged 32 weeks were used. Layers were allowed to adapt to new feed for 14 days and experiment conducted for three months. Five treatments were used, 0, 20, 30, 40, and 50 *Prosopis juliflora* pods substituting maize in layers diets. Nine birds were used per treatment. Analysis of data was done using SAS version 9.0 (2002). The treatment means that were significantly different were separated using the Least Significant Difference (LSD) test at $P<0.05$. Five isocaloric and isonitrogenous experimental diets were prepared at Egerton feed mill. The gross energy was 13.2 MJ/kg while the crude protein was 18% for all treatments.

Results and discussions

Table 1. Amino acids profile of *Prosopis juliflora* pods from Marigat in Baringo County, Kenya

Parameter	Mg/g DM in pods
Essential amino acids	
Lysine	4.25
methionine	9.1
leucine	5.97
isoleucine	3.02
cystine	1.31
phenylanine	3.39
tyrosine	Didn't do
threonine	0.3
valine	4.21
tryptophan	Didn't do
Non-essential amino acids	
alanine	4.41
arginine	7.94
glycine	5.17
histidine	2.37
proline	7.21
serine	4.65
Aspartic acid	13.82
Glutamic acid	13.91

Table 2. Proximate analysis and minerals of *Prosopis juliflora* pods from Marigat in Baringo County, Kenya

Proximate analysis			Minerals	
Nutrient	***Prosopis juliflora*** %DM pod	White maize %DM	Mineral	PPM
Dry matter	90.38	88.58	phosphorus	252.46
Crude protein	15.52	10.09	Potassium	652.02
Crude fiber	22.53	3.52	calcium	292.0
Ether extract	1.86	3.10	magnesium	92.15
Ash	4.25	1.00	sodium	66.27
Average Gross			iron	93.32
Energy MJ/kg	15.68	15.54	copper	32.05
moisture	9.62	11.42	zinc	74.40
			manganese	17.89

Table 3. Feed intake between the five treatments

Treatment	Feed intake L
1	1337.86111[b]
2	1333.89524[b]
3	1414.69167[a]
4	1409.72222[a]
5	1461.44167[a]

Means in same column that do not share a superscript letter are significantly different (at 5% level of significance)
T1= 0%; T2= 20%; T3= 30%; T4= 40% and T5= 50% incorporation of *Prosopis* pods feed

Table 4. Egg production between treatments

Treatment	Egg production
1	5.7[a]
2	5.5[a]
3	4.4[b]
4	5.7[a]
5	5.1[a]

Means in same column that do not share a superscript letter are significantly different (at 5% level of significance).
T1= 0%; T2= 20%; T3= 30%; T4= 40% and T5= 50% incorporation of *Prosopis* pods feed

The amino acids profile showed high level of essential and limiting amino acids lysine and methionine (Table 1). The proximate analysis shows *Prosopis juliflora* pods being a source of both energy and protein. This is crucial because of the high cost of proteins and competition on cereals as energy sources between man and animals. The high fiber limits the use of *Prosopis juliflora* pods as a feed ingredient in monogastrics. This is because non ruminants are not able to digest fiber beyond 6% of the total diet. This research looked at what effect would fiber hydrolyzing enzymes have on highly fibrous layers feed. *Prosopis juliflora* pods are a source of phosphorus, potassium and calcium. Calcium and phosphorus are paramount minerals for egg shell formation. Treatment 1 was control feed with no *Prosopis juliflora* pods, treatment 2, 3, 4 and 5 had 20%, 30%, 40% and 50% *Prosopis juliflora* pods substituting maize in the layers feed. Feed intake was not different between control and where there was inclusion of 20% *Prosopis* pods however it was significantly higher following addition of 30%, 40% and 50% *P. juliflora* as a feed component. This is because as fiber content was increased in the feed, layers had to fed more to get same nutrients as a feed with low fiber < 6% crude fiber. From the results on egg production, maize can be substituted by *Prosopis* pods up to 50 % in layers feeds without affecting egg production.

Conclusion

Prosopis juliflora pods can be used as energy and protein source for layers. The results indicated that the higher the fiber in layer diet, the higher the feed intake. Therefore, in diet of indegenous chicken, hydrolyzed *Prosopis juliflora* pods can substitute maize up to 50% in layers diets without affecting egg production.

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