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Research Application Summary

Edible grasshopper meal *(Ruspolia nitidula)* "nsenene" a potential source of protein in the diet of Japanese quails in Africa: A review

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Abstract

The diet of Sub Saharan Africans has been noted to contain low levels of protein compared to those in the first world. This situation has affected the proper growth of children who are malnourished and the health of adults living under poverty line. Quails are small birds currently widely spread throughout the world. They are potential source of a much needed animal protein since their eggs and meat have been categorized as high quality animal products. These hardy and small bodied birds can be easily produced as a backyard venture by families living both in the villages and towns since they occupy small space, and are resistant to many diseases that attack chicken and other poultry birds. The biggest challenge in production of these birds is the cost of feeds which is the largest contributor to the cost of production. Quails diet, like for chicken and other domesticated birds, is based on cereal grains and nuts which include; maize, soybean meal, groundnut cake, soybean meal, sorghum, millet and rice or wheat bran as the most commonly used plant products for feeding quails. Unfortunately, these are low in essential amino acids (methionine and lysine) which are important constituents in quail diet calling for inclusion of expensive animal protein sources such as fish meal, meat meal, blood and bone meal. The high cost of these alternative protein sources is a major hindrance for their inclusion in the preparation of quail feed. Grasshoppers (*Ruspolia nitidula*) have been reported to contain 36–40% protein and can serve as cheap sources of protein in quail diet. Their inclusion in the diet of Japanese quails is comparable to using fish meal with 50% of fishmeal potentially replaceable by grasshopper meal without affecting growth, optimum meat and egg production or fecundity.

Key words: Grasshoppers, protein, *Ruspolia nitidula,* quail meal

Résumé

Il a été noté que le régime alimentaire des Africains subsahariens contient de faibles niveaux de protéines par rapport à ceux du monde premier. Cette situation a affecté la croissance adéquate des enfants souffrant de malnutrition et la santé des adultes vivant sous le seuil de pauvreté. Les cailles sont de petits oiseaux actuellement largement répandus dans le monde.

Ils sont une source potentielle de protéines animales indispensables, car leurs œufs et leur viande ont été classés comme des produits animaux de haute qualité. Ces oiseaux robustes et de petite taille peuvent être facilement élevés par les familles vivant dans les villages et les villes, car ils occupent un petit espace et sont résistants à de nombreuses maladies qui attaquent les poulets et autres volailles. Le plus grand défi dans la production de ces oiseaux est le coût des aliments qui est le plus gros contributeur au coût de production. Le régime alimentaire des cailles, comme pour le poulet et d'autres oiseaux domestiques, est basé sur les céréales et les noix qui comprennent ; maïs, tourteau de soja, tourteau d'arachide, tourteau de soja, sorgho, millet et son de riz ou de blé comme produits végétaux les plus couramment utilisés pour l'alimentation des cailles. Malheureusement, ceux-ci sont pauvres en acides aminés essentiels (méthionine et lysine) qui sont des constituants importants dans l'alimentation des cailles, ce qui nécessite l'inclusion de sources de protéines animales coûteuses telles que la farine de poisson, la farine de viande, le sang et la farine d'os. Le coût élevé de ces sources alternatives de protéines est un obstacle majeur à leur inclusion dans la préparation d'aliments pour cailles. Il a été rapporté que les sauterelles (*Ruspolia nitidula*) contiennent 36 à 40% de protéines et peuvent servir de sources de protéines bon marché dans l'alimentation des cailles. Leur inclusion dans le régime alimentaire des cailles japonaises est comparable à l'utilisation de farine de poisson avec 50% de farine de poisson potentiellement remplaçable par de la farine de sauterelle sans affecter la croissance, la production optimale de viande et d'œufs ou la fécondité.

Mots clés: sauterelles, protéines, *Ruspolia nitidula*, farine de caille

Introduction

Raising of quails is a new venture in sub Saharan Africa to alleviate the problem of protein requirements of poor malnourished children and adults living under the poverty line (FAO, 2013). Quails, birds that belong to the pheasant family and believed to have originated from North America, but are now widely spread throughout the world are potential sources of the much needed animal protein. Quails are present in Europe, Asia, Africa, Australia and South America. The domesticated species are kept for their eggs which is of high quality. These birds can be easily produced as a backyard venture by families living both in the villages and towns. They are hardy with small body size, occupying smaller space, and resistant to many diseases that attack chicken and other poultry birds (Schirtzinger and McDermott, 2017). Quails are fast growing birds and layers can start producing eggs within six weeks with the provision of balanced diet. The protein content of quails' eggs and meat is higher than for chicken and other poultry birds (Chepkemoi, 2015). Putting up a structure using locally available materials to house quails requires little space. In addition to their commercialization in limited locations in Africa, quails have an outstanding potential for village backyard production (Karen, 2016) due to their little space requirement. Low volume, weight, feed and space requirement make their production possible with lower capital investment as compared with other domestic birds. The largest percentage of cost of production in raising Japanese Quails is due to feed which covers between 70 to 75 percent of total production cost (Nasar *et al.,* 2016; Cabaral *et al.,* 2017). This high cost of feed results from the need to add valuable protein content in quails' feed to meet the essential amino acid requirements of these birds. The commonest protein sources for poultry feed include fish meal, bone meal, blood meal, cotton seed cake, soybean meal (Linden, 2013) all of which are expensive sources of protein. According to FAO (2012), the production of animal feeds will have to increase by 70 per cent to be able to produce enough human consumable protein (beef, pork, poultry) that will feed the world by 2050.

Certain insect species can be used as animal feed or quail feed. Despite this, little has been reported about the opportunities offered by insects as source of feed for quails or as feed constituents (Linden, 2013). It is currently necessary to start seeking for alternative sources of protein that can sustainably be used as constituents of animal feed. According to Van Huis (2015), promising results have been reported from feasibility studies going on in western countries to find alternative protein sources for both human consumption and animal feeds. The International Institute of Insect Physiology and Ecology (ICIPE) has also made effort towards promotion of insects for human, animal and poultry consumption. *Ruspolia nitidula* (nsenene) has been identified as good source of protein that can replace 50% of the traditional protein ingredients used in the feeds of Japanese quails.

Nutritional requirements of quails. Quails require a nutritionally balanced ration to enhance optimum egg production and quality meat for human consumption. The proportions of using various ingredients to formulate feeds vary depending on age, purpose of production as well as the quality of ingredients. The dietary requirements for most birds nearing maturity are similar except that calcium and phosphorus levels need to be increased for laying quails. Shell grit or ground limestone is added to the diets after five weeks of age, or it may be provided separately as free choice (Randall and Bolla, 2008) as a means of supplying calcium to the birds. Quail layers diets are expected to have 24% protein, 11.7 MJ of metabolisable energy per kilogram, and 2.5%–3.0% calcium. The latter may need to be increased to 3.5% in hot weather when the birds eat less feeds but still require calcium to maintain egg production (Randall and Bolla, 2008). Adult Japanese quail eat between 14 g and 18 g of food per day (Randall and Bolla, 2008). It is important therefore to obtain fresh feed that can be stored in covered containers with tightly fitting lids in clean, dry, cool areas free from animals and vermins. Feed stored longer than eight weeks is subject to vitamin deterioration and rancidity, especially in periods when feeds are scarce.

Research has indicated that nutrient requirements of Japanese Quails are variable depending on the age of the birds, growth, egg laying and purpose of production (Atien *et al.,* 2016). Quails diet, like chicken and other domesticated birds, is based on cereals grains and nuts. Altine *et al.* (2016) identified maize, soybean meal, groundnut cake, sorghum, millet and rice or wheat bran as the most commonly used plant products for feeding quails. Soybean meal has been found to be the most balanced vegetable protein source available in Uganda (Amaza and Ubosi, 2007) with up to 41% protein content (Onyango, 2017). It is noted to contain very rich lysine and other essential amino acids except methionine. Methionine and lysine are generally low in plant products (Babangida and Ubosi, 2006) calling for inclusion of animal products. Animal protein products such as fish meal, meat meal, blood and bone meal are good sources of most of the essential amino acids, but they are usually more expensive than plant protein ingredients (Altine *et al.,* 2016) which in many cases hinder poultry production. Addition of synthetic methionine and lysine has been indicated to balance amino acid composition in such diets.

Quail eggs. Quail eggs are small in size but very nutritious, packed with vitamins and minerals, and their nutritional value is three to four times greater than for chicken eggs (Tunsaringkarn, 2013). Studies have revealed that these eggs contain 13 percent proteins compared to 11 percent in chicken eggs and contain 140 percent of vitamin B1 compared to 50 percent in chicken eggs. Furthermore, quail eggs provide five times as much iron and potassium and unlike chicken eggs, quail eggs have not been known to cause allergies or diathesis (Tunsaringkarn, 2013). They help fight allergy symptoms due to the ovomucoid protein they contain. The composition of quail's diet is similar to that of chicken. The basis of the availability of these nutrients hangs on the energy requirement of the bird. Protein and amino acids are essential part of the diet of these birds. In a study reported by Soares *et al.* (2003) protein requirement of Japanese quail (*Coturnix Coturnix Japonica*) were 23.08% and 21.95% of crude protein in the diet for the rearing period (7 to 35 days) and laying period (42 to 98 days).

Grasshoppers as source of protein. Grasshoppers have been reported to replace fish meal, which is becoming increasingly scarce and expensive as a protein source in feed. Sseppuuya *et al.* (2017) indicated that grasshopper (*Ruspolia nitidula*) also called "nsenene" (in Uganda) contains 36–40% protein. This presents the native insect species as a potential substitute that can provide a cheaper source of protein in poultry feed in Africa. Grasshoppers can be collected and reared in confinement under facilities (Oonincx and de Boer, 2012). Edible grasshoppers are a delicacy of many homes in Uganda and other African countries, and have been identified as a rich source of protein (Kelemu *et al.,* 2015). Its inclusion in the diet of Japanese quails is comparable to using fish meal and soybean meals. Insect farming such as the rearing of grasshoppers has been rated advantageous compared to animal production considering that the former requires less land and water with less greenhouse gas emissions than the latter. Huis *et al.* (2017) argued that insects have higher feed conversion efficiencies compared to animals and can transform low-value organic by-products into high-quality feed.

Nutritional composition of Grasshopper. Research shows that 100 g of cooked insects provide more than 100 % of the daily requirements of the respective contained vitamins/ minerals (Agea *et al.,* 2008). A study conducted on nutritional composition, quality, and shelf stability of processed *Ruspolia nitidula* (edible grasshoppers) by Ssepuuya *et al.* (2017) established that nsenene (*R. nitidula*) is nutritious with 36–40% protein, 41–43% fat, 2.5–3.2% carbohydrate, 2.6–3.9% ash, 11.0–14.5% dietary fiber, and 900– 2300 µg/100 g total carotenoids on a dry matter basis.

Grasshopper meal in quail feed. As far as inclusion levels of grasshopper meal in quail feeds are concerned, 50% of fishmeal can be replaced by grasshopper meal without affecting growth or fecundity (Haldar, 2012; Van Huis *et al.,* 2013). This partial replacement of fish meal with grasshopper meal has been found suitable in quail's diet. In India, Japanese quail (*Coturnix japonica japonica*) were fed with various diets in which grasshopper meal (*Oxya hyla*) gradually replaced fish meal and the best results were obtained with the inclusion of 50% of Oxya (Haldar *et al.,* 2012). Fecundity (the number of eggs laid per female) was significantly higher, compared with the control treatment (Haldar *et al.,* 2012). In Nigeria, a similar study revealed better body weight gain, feed intake and feed conversion ratio

(Adeyemo *et al.,* 2008). In another study conducted by Ojewola *et al.* (2005b), grasshopper meal which included 2.5% of the diet was found to be a suitable and cheap substitute for imported fish meal. In China, meal from the grasshopper *Acrida cinerea* replaced 20% and 40% fish meal in broiler diets without reduction in growth rates and feed consumption as the control diet (Liu *et al.,* 2003.

Anti-nutritional factors in Grasshopper. Occasionally, substances generated in natural food substances by the normal metabolism of species and by different mechanisms exert effects contrary to optimum nutrition. Such factors also referred to as anti-nutritional factors include trypsin inhibitor, phytic acid and cyanogens (Ghosh *et al.,* 2016). They act through inactivation of some nutrients, diminution of the digestive process or metabolic utilization of feed, chelate and inhibit the release of nutrients for animal absorption. A comparative study carried out by Omotos and Adesola (2018) on the composition of *R. phoenicis* (nsenene) and some insect disorders revealed that all the insects had anti-nutrients such as tannin, polyphenol, phytate, oxalate, saponin, alkaloids and flavonoids at tolerable quantities. This is an indication that when "nsenene" is included in the diet of quails, protein in form of essential amino acids would be readily available for absorption and utilization without chelation of any sort.

Conclusion

Sub-Saharan African faces nutritional insecurity especially when it comes to protein inclusion in the diet. This problem has led to malnutrition of children leading to stunted growth and health problems of the elderly. Raising quails can alleviate such problems since it is cheap and low cost materials can be used to construct a house to confine them. High cost of feed ingredients especially those of protein in form of fishmeal, meat meal and soybean meal hinder quail raising by poor farmers. *Ruspolia nitidula* ("nsenene") has been identified as a substitute and a cheap source of protein comparable to fish and soybean meal to include in quails' diet. With such realisation, quail raisers and poor farmers who love to go into quail production will find it expedient to undertake such venture to meet the dietary protein needs of ever increasing population in Sub-Saharan Africa.

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