

The School Feeding Programme: Profiling ‘Lesser Utilized’ Animal Source Foods as Alternative Home Grown Options for Feeding Preschool Children in Nigeria

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Abstract

There have been renowned shortages of protein and micronutrient from ASFs in most SFP menus despite the intended benefits of having a strong positive link between the intake of ASFs and improved cognitive, behavioural and physical development of preschool children. Much emphasis has been on the use of ‘conventional’ ASFs (mostly milk, chicken, fish, egg and beef) in SFPs in Nigeria. This article has exposed other nutritionally beneficial ASFs referred as the ‘lesser utilized’ animals (LUAs) such as insects, quails, rabbits, snails and ducks and their products that has been neglected due to restrictions by religion, food taboos, culture, ethnicity and other socio-economic factors. Detailed nutritional profiling of these animals ranging from the benefits, simplicity and reduced capital investments in production compared to their ‘conventional’ livestock counterparts has been x-rayed. It has been advocated that ASFs from LUAs be incorporated as better alternatives to boost protein and micronutrients supplies in SFPs in Nigeria because of the quality of nutrients they possess. However, to encourage a wide range of acceptance of these ASFs it is recommended that more awareness be created on the nutritional qualities of the products from LUAs via the media to encourage their utilization, training programmes for youths and adults should be organized to gain knowledge on the husbanding methods for these animals in their homes to boost local supplies for SFPs, there should be a strong advocacy to encourage the consumption of these animals as well as adopting attractive processing and preservation methods to improve the value of animal products, especially edible insects.

Key words: School feeding programme, Animal source foods, ‘Lesser utilized animals’, Protein and micronutrients, Preschool children

INTRODUCTION

The School Feeding Programme (SFP) was launched by the Federal Government of Nigeria through the support of the United Nations’ Children Education Fund (UNICEF) and the New Partnership for Africa’s Development (NEPAD) in 2005. The sole objective of this programme was to fight short-term hunger among school pupils by providing at least one daily nutritious meal to support access to education (Falade et al., 2012). According to WFP (2009), this programme was built on the premise that, food can entice poor children to school,

improve school admission, attendance and cognition as well as help to reduce the number of school drop-outs, illness and enhance disease awareness. It was further explained that meals provided at school can reduce household expenses on food which can result in increased returns on investment by parents or guardian (WFP, 2009).

A healthy food and nutrition should be a high priority on every SFP because of the positive affect on child well-being. It is imperative that diets that fill the actual micronutrient gaps in the rations of school-age children be utilised as these have a higher nutritional quality and can be expected to have greater impacts on learning (FAO/WHO, 1991). Ensuring the inclusion of the appropriate level of proteins and micronutrients in the school ration for children may require more than simply selecting the appropriate mix of foods. Therefore, including additional nutrients through the use of Animal Source Foods (ASFs) to basic school diets may be an option if the size of the ration is relatively small and where the available basal staple foods do not contain a high level of the most essential micronutrients. Similarly, there has been a strong positive link between the intake of ASFs and improved cognitive, behavioural and physical development of preschool children in Kenya (Neumann et al., 2003).

A nationally representative survey conducted from 1993 to 2005 by the World Health Organization (WHO) revealed that 47% of preschool children worldwide suffer from anaemia, as a result of iron deficiency (Daphna and Lindsay, 2011). Similarly, more than 40% of pre-schoolchildren in Sub-Saharan Africa and South East Asia are deficient in vitamin A (WHO, 2009). Furthermore, across the various sub-regions of the world zinc insufficiency is estimated to affect 5% to 79% of children under five years of age, with the highest prevalence in South Asia and Sub-Saharan Africa (Caulfield, 2006). These micronutrients can best be derived from ASFs. Therefore, limited availability, accessibility and intake of ASFs at the household level and lack of knowledge about their value in the diet and role in health may contribute to poor diet quality in SFPs.

Animal source foods (ASFs) are valued sources of complete, high-quality, effortlessly digestible protein and many essential micronutrients such as iron, zinc, calcium, vitamin A, and vitamin B12 (Schönfeldt, 2013). Animal source foods (ASFs) can be derived from cattle, sheep, goats, pigs, chickens, and 'lesser-utilized' animal species. These animals principally provide meat, milk and egg products with the supply of a wide array of micronutrients that are hard to obtain in adequate amounts from plant-source foods alone (McNeill, 2007).

In Nigeria among the pupils of private and public schools, the most commonly used staple foods for SFPs are cassava based followed by rice alongside with soup and stew of animal or fish products (Olusanya, 2010). Falade et al. (2012), reported a combination of rice and fish, porridge, rice and cowpea, cowpea and egg. In Ghana it has been rice, plantain, yam, 'banku', beans, garri ball combined with tomato-stew, beans-stew, garden egg-stew, egg-stew, cabbage-stew, groundnut soup, 'palaver-sauce' (a stew containing 'nkontomire' leaves - dark-green leaves of the coco-yam plant) and basically fish (Martens, 2007). Similarly, the Ministry of Education (MOE) in Botswana prescribed bread, corn products, sorghum products, rice and mashed potatoes as energy sources. Beef, including ground beef, chicken, beans, and milk were foods offered weekly from the body building food group. Protective foods offered weekly included vegetables (i.e., cabbage, mixed vegetables and pumpkin) and fruits (i.e., apples and oranges) (Mosie, 2004). In Kenya, porridge, 'ugali/kales' and meat, 'githeri', rice and beans has been the major foods in their SFP menus (Otieno, 2014).

A critical observation of the various food menus provided in most SFPs in Nigeria revealed that the use of supplemental ASFs in diets has focused on the use of the 'conventional' animal products such as beef, chicken, eggs, milk and fish. The use of these food sources has shortly tackled the animal protein supplies and micronutrient availability in

most SFPs in Nigeria because of the competitive demands of these products. There has been a new wave of interventions in the livestock production industry to explore the domestication and production of the ‘lesser utilized’ animals to boost animal protein security. This article is therefore aimed at bringing to limelight the importance and benefits of the ‘lesser utilized’ ASFs for incorporation into the Nigerian SFPs to boost animal protein supplies and micronutrient availability to prevent undernourishment that can result to poor brain development, disease infections, emotional frustrations and poor academic performance among preschool pupils (Otieno, 2014).

THE ‘LESSER-UTILIZED’ ANIMALS

‘Lesser utilized’ animals may be described as those animals and their products that are not conventionally consumed due to restrictions as influenced by religion, food taboos, culture, ethnicity, personal dislikes and other socio-economic factors. They may in some spheres of animal production be classified as non-conventional livestock, mini-livestock, micro-livestock or alternative livestock. They can further be defined as any un-traditional animals raised in house hold or commercial farms as source of food (Myers, 2016).

Indigenous people across the world including Nigerians in one way or the other may have consumed these ‘lesser utilized’ animals which may include, edible rodents like grass cutter, guinea pig and the giant rats; insects like palm worms and termites; reptiles like lizards and snakes; amphibians like frogs; gastropods like snail; and other lower members of the animal kingdom. Others may consume poultry species like quails, pigeons, guinea fowls and ducks. This article will attempt to unravel the benefits of some of these animal species as alternative ASFs for use by the implementers of SFPs in Nigeria.

Justifying the Use of Edible Insects as Alternative ASFs for Protein and Micro-nutrient Supplies in the Nigerian SFP

The global acceptance and utilization of edible insects as food

Insect consumption (entomophagy) is not a new concept in many parts of the world. Available information suggests that 30 species or more of edible insects are used by indigenous populations in many underdeveloped and developing countries (Agbidye et al., 2009). Dufour (1987) reported that in Colombia, insects provide 12% of the men’s diets and 26% in women’s diets and in most cases; insects were used to check fluctuations in the availability of fish and game. Insects are very widely consumed and in those cultures in which the use of insects as food is traditional, they are highly priced and sought after. They are usually incorporated as a consistent part of the diet when in season or throughout the year if available (Defoliart, 1989). In Nigeria the yam beetle (*Heteroligus meles*) and grasshopper (*Zonocerus variegatus*) are commonly eaten by some people in the South Eastern region and some parts of Benue State, while larva of the palm weevil, *Rhynchophorous phoenicis* Fabr. , are eaten in several parts of Oyo, Ondo, Osun, Ekiti, Ogun, Lagos , Delta and Edo States (Ekop et al., 2010; Elemo et al., 2011). The larva of *Oryctes monoceros* is consumed in the Niger Delta regions (Ifie & Emeruwa, 2010). The population of variegated grasshopper (*Zonocerus variegatus* (Linn.)), is high during the dry season in the South western parts of Nigeria and has been reported eaten in the Akoko area of Ondo State (Fasoranti and Ajiboye, 1993). The winged termites locally known as ‘aku’ in Ibo, ‘chingé’ in Hausa and ‘Esusu’ in Yoruba are regarded as traditional delicacies (Fasoranti & Ajiboye, 1993). *Macrotermes nigeriensis* and *Macrotermes bellicosus* are enjoyed in all parts of Nigeria, especially because it is present at the onset of the rainy season when

livestock products are in short supply, new crops have not yet produced food, and stored food produced from the previous growing season is running low (Banjo *et al.*, 2006). The dung beetle (*Aphodius rufipes*) has been reported as a traditional delicacy of the Gbagyi people in Niger State (Paiko *et al.*, 2012). The caterpillar of *B. alcinoe* popularly called 'Egu' is consumed by the Igbo speaking tribe of Eastern and Southern parts of Nigeria (Amadi *et al.*, 2005; Braide *et al.*, 2010). The larva of *Lepidoptara litoralia* is common and consumed in the North Central region of Nigeria especially in Plateau State (Solomon & Prisca, 2012).

The comparable nutritional value of edible insects with conventional livestock

The nutritional value (amount of proteins, fat, vitamins and calories) of insects compares very favourably with that of meat and fish (Nkouka, 1987). Insects contain a high amount of crude protein. For instance, in g/100 g dry weight, caterpillars contain 50–60, palm weevil larvae 23–36, Orthoptera 41– 91, ants 7–25, and termites 35–65 (Bukkens, 1997). Similarly, it has been reported that one hundred grams of caterpillars provide 76% of an individual's daily protein requirement, and more than 100% of the daily requirements for many of the vitamins and minerals (Santos Oliveira *et al.*, 1976).

Insects in general are rich in fat, especially caterpillars, palm weevil larvae and termites (Bukkens, 1997). Reports reveal that of the micronutrients, iron and vitamin A deficiency affects about 50 percent of the children in Africa (ACC/SCN, 2000) and insects have been seen as a good source of iron (Fe) as well as vitamins A and B (Bukkens, 1997). Similarly, being an animal food, they contain even more bio-efficacious micronutrients than vegetables (Bukkens, 1997).

The fast and better feed conversion potentials of edible insects

As the demand for meat rises, so does the need for grain and protein feeds. This is because far more plant protein is needed for an equivalent amount of animal protein. Pimentel and Pimentel (2003) calculated that for 1 kg of high-quality animal protein, livestock are fed about 6 kg of plant protein. Feed-to-meat conversion rates (how much feed is needed to produce a 1 kg increase in weight) vary widely depending on the class of the animal and the production practices used. Typically, 1 kg of live animal weight in a typical United States production system requires the following amount of feed: 2.5 kg for chicken, 5 kg for pork and 10 kg for beef (Smil, 2002). Insects require far less feed. For example, the production of 1 kg of live animal weight of crickets requires as little as 1.7 kg of feed (Collavo *et al.*, 2005). When these figures are adjusted for edible weight (usually the entire animal cannot be eaten), the advantage of eating insects becomes even greater (van Huis, 2013). Nakagaki and DeFoliart (1991) estimated that up to 80 percent of a cricket is edible and digestible compared with 55 percent for chicken and pigs and 40 percent for cattle. This means that crickets are twice as efficient in converting feed to meat as chicken, at least four times more efficient than pigs, and 12 times more efficient than cattle (Nakagaki & DeFoliart 1991).

The ability of edible insects to be reared sustainably under organic waste materials

A benefit of insects as an alternative animal protein source is that they can be reared sustainably on or from organic waste materials (e.g. manure, pig slurry and compost). The use of organic waste materials in insects production starts by rearing the insects on bio waste (Veldkamp *et al.*, 2012). Insect species such as the black soldier fly (*Hermetica illucens*), the common housefly (*Musca domestica*) and the yellow mealworm (*Tenebrio molitor*) are very efficient at bio converting organic waste. For this reason, these species are receiving

increasing attention, as they could collectively convert 1.3 billion tonnes of bio waste per year to edible insects (Veldkamp et al., 2012).

Justifying the Use of Quails as Alternative ASFs for Protein and Micro-nutrient Supplies in the Nigerian SFP

The quail and its importance

Quails are small game or hunting birds which are used for eggs and meat production (DAFF, 2013). They are usually found in the wild as migratory birds living in grassland and cultivated fields (MOLD, 2012). Quails belong to the same family as the domestic fowl, the pheasant and the peacock (Wilkinson, 1999). At first quails became popular as game birds but at later stage in 1910 the commercial keeping of quail kicked off because of their tasty meat, low feed consumption and excellent egg laying abilities (Shanaway, 2008). Quail is an ideal food as authenticated in the Holy Bible and the Holy Koran and has no religious taboos. Quails can be raised commercially for the purpose of profitable eggs and meat production (Chege, 2014).

According to Onyewuchi et al. (2013), quail farming is more profitable than other poultry. These authors noted that, quails have various benefits such as:

- They mature earlier and start laying eggs after 5-6 weeks of age.
- They lay a greater number of eggs 280-300 in a year.
- Their eggs take about 16 to 18 days to hatch.
- They have high immunity against diseases.
- They are poor feeders and they require small floor space.
- Their meat is low in fat and the eggs are perceived to have nutritional and medicinal value (MOLD, 2012).
- They produce 220 to 250 grams of meat from 7 to 7 ½ weeks.
- Meat and eggs of quail are very tasty, delicious and nutritious and are source of high quality protein (Bakoji et al., 2013).
- Quails are very hardy and almost all types of weather conditions are suitable for starting a quail farming business (NRC, 1991).

Quail meat quality and micronutrient composition

Quail meat is an authenticated ideal food, which is tender, very delicious with low calorific value and high dry matter (Sonale et al., 2014). Moreover the nutritional as well as medicinal value of quail meat is very high. Quail meat, particularly the breast fillet is very lean. The essential amino acids content of quail breast meat is 6.5 % higher than the leg meat especially in isoleucine and valine concentration (Genchev et al., 2008). In Nigeria quail production has gained attention and more patronage due to the leanness and low cholesterol of the meat (Gardward & Diehl, 1987). The proximate nutrient compositions for male and female quails are within the range of: 24.46 – 25.65% Dry matter (DM), 19.58 – 20.00% Crude protein (CP), 3.57 – 4.63% Fat, 1.14 – 1.21% Ash and 111.67 – 120.86 kcal/100g Energy. Similarly the average mineral compositions for male and female quails ranged within 139.1 – 151.3 mg/kg Calcium (Ca), 1681.7 – 1795.8 mg/kg Phosphorus (P), 6.8 – 8.1 mg/kg Iron (Fe) and 9.6 – 10.5 mg/kg Zinc (Zn) (Yalcin et al., 2005). Genchev et al., (2008) reported the following for proximate nutrient composition and minerals respectively for breast meat of quails as 27.51% DM, 23.38% CP, 2.21% Fat, 0.40% Nitrogen Free Extract (NFE), 1.51%

Ash, 0.019% Ca, 0.222% P, 0.061% Na, 0.402% Potassium (K), 0.018% Magnesium (Mg), 1.882mg% Fe, 0.362 mg% Copper (Cu) and 2.002 mg% Zn.

Quail egg quality and micronutrient composition

Quail eggs have important drug value. The eggs are used for many therapeutic purposes for preventing digestive disturbances, anaemia, tuberculosis, ulcer, high blood pressure, diabetes, arteriosclerosis, asthma and stimulation of growth in children (Anca et al., 2008). Quail egg consumption has no negative effects. It is a natural source of vitamins and mineral substances. It contains 1.4 % cholesterol compared to hen eggs which has 4 %; about 3 times less fats; 23 % yolk proteins compared to 16-17 % in hen eggs yolk. Regarding the vitamins and minerals content, the quail egg has 6 times more aneurin, 5 times more phosphorus and iron, 15 times more lactoflavin, and antiallergical agents than hen eggs content (Anca et al., 2008).

Quail eggs strengthen the immune system, promote memory health, increase brain activity and stabilize the nervous system. They help prevent anaemia by increasing the level of hemoglobin in the body while removing toxins and heavy metals (Lalwani, 2011)

An average whole quail egg weighs 10.67 g. Their contents of ash, carbohydrate, fat, protein and moisture are 1.06, 4.01, 9.89, 12.7 and 72.25 g 100g⁻¹, respectively. The total energy in calories of the whole egg is 156.50 kcal 100g⁻¹. The most essential amino acid found in their egg whites is leucine and the most non-essential amino acid found is aspartic acid. Their egg yolks are rich in essential fatty acid contents of linoleic acid and the highest non-essential fatty acid content of oleic acid (Tunsaringkarn et al., 2013). Their eggs are also high in content of vitamin E, nitrogen and iron. Quail egg is more nutritious in terms of energy and protein than chicken eggs (Thomas et al., 2016).

Justifying the Use of Rabbits as Alternative ASFs for Protein and Micro-nutrient Supplies in the Nigerian SFP

Importance of rabbit production

The Rabbits scientifically known as *Oryctolagus cuniculus* have a potential as meat producing animals in the tropics due to their characteristic small body size, short generation interval, rapid growth rate and ability to utilize forage or agricultural by-products. They can contribute significantly to solving the problem of meat shortage in all most every part of the world (Lebas, 1983), since meat from rabbits has a low cholesterol level, high protein/energy ratio and is relatively rich in essential fatty acids (Iraqi, 2003) and it is claimed that there are few traditional/social taboos concerning the eating of the rabbit meat (Mamattah, 1978).

According to Ruiz-Feria et al. (1998) rabbits can subsist on inexpensive diets based on forages under small-scale farm conditions in arid and tropical regions. Agricultural by-products, foliages and plants such as *Centrosema pubescens*, cassava root meal, rice bran, natural grasses and *leucaena* can be used as dietary ingredients for rabbits (Ruiz-Feria et al., 1998). They can utilize waste products more effectively thus serving as an alternative to other species for the improvement of protein supply to the human population and the realization of monetary income by putting into effective use the waste materials that are inedible for humans (Schlolaut, 1985).

Rabbit meat quality and micronutrient composition

Rabbit meat is highly valued for its nutritional and dietary properties. It is a lean meat with a low-fat content and less saturated fatty acids and cholesterol than other meats (Hernández, 2008). From the nutritional point of view, rabbit meat has a good taste and aroma and is easily digestible, with high nutritional and dietetic properties. The meat contains 20–21% of proteins, unsaturated fatty acids (oleic and linoleic; 60% of all fatty acids), potassium, phosphorus, and magnesium (Simonova et al., 2010). It has low concentrations of fat, cholesterol, and sodium (Hermida et al., 2006). It is better digested as compared to other kinds of meat (beef, lamb, or pork (Enser et al., 1996) and is recommended for consumption, e.g. for persons with cardiovascular illnesses (Hu & Willett, 2002). Similarly, the energy value of rabbit meat (427–849 kJ/100 g of fresh meat) is comparable to various commonly consumed sorts of red meat (Dalle Zotte, 2002).

Justifying the Use of Snails as Alternative ASFs for Protein and Micro-nutrient Supplies in the Nigerian SFP

Snail meat quality and micronutrient composition

Snails are environment-friendly animal species that can be reared in backyard of most households in West Africa. The capital, technical, labour and financial inputs required in snail farming are relatively low compared to those in other types of livestock farming (poultry, pigs, goats, sheep and cattle) (Cobbinah, 2008).

The meat of the African giant land snail (*Archachatina marginata*) traditionally has been a major source of protein in the diet of people in Nigeria (Ebenso, 2003). In Ghana, it forms about 1% of the ASFs (Townsend, 1985). It is a high quality food that is rich in protein and low in fats as well as a good source of iron (3.5 mg/100 g) (USDA, 2006). The protein content of the meat (88.37%) compares with some other animal protein sources from pork (82.42%) and beef (92.75%) (Imevbore, 1988). Snail meat contains all the essential amino acids such as lysine, leucine, isoleucine and phenylalanine which are needed by the body for its metabolic activities (Ebenso, 2003). They are a rich source of major minerals such as calcium, sodium, iron, zinc, potassium and magnesium (Ademolu et al., 2004). The meat and fluid has some medicinal value and can be used to treat ailments including whooping cough, anaemia, asthma, and high blood pressure due to their relatively low cholesterol level and high mineral content (Akinusi, 1998). Its edible carcass has a fat content of only 1.3% and iron content of 12.2 mg/100 g that compares to the nutritive value of domestic livestock (Anthony, 2010).

Justifying the Use of Ducks as Alternative ASFs for Protein and Micro-nutrient Supplies in the Nigerian SFP

Importance of Duck keeping

The ducks are waterfowls. The production of ducks can contribute to the improvement of the nutritional standards of the world's human population (Pingel, 2004). Ducks, like chickens, are good producers of eggs and meat. They have approximately the same housing requirements as chickens, especially when they only require night shelter (van der Meulen & den Dikken, 2004). Their production and introduction of their meat and eggs for use in boosting protein and micronutrient supplies in SFPs is worthwhile. According to Bachan (2016), duck keeping has the following advantages:

- They lay more egg per bird per year than chicken.
- The size of their eggs is larger than hen egg by about 15 to 20 g.
- They require lesser attention and thrive well in scavenging conditions. With very little time and work you can raise a small flock of ducks.
- They can supplement their feed by foraging on grasses and eating insects, snails, earthworms, small fishes and other aquatic materials.
- From a commercial point of view, they have a longer profitable life. They lay well even in the second year.
- They do not require any form of elaborate housing like chicken.
- They are hardy, more easily brooded and more resistant to common avian diseases.
- Marshy river side, wet land and water logged areas where chicken or other types of stock will flourish, are excellent quarters for duck farming.
- They lay 95–98% of their eggs in the morning, thereby saving a lot of time and labour.
- They are suitable for integrated farming systems such as duck-cum-fish farming

Meat and egg qualities of Ducks

Meat and eggs from ducks (waterfowls) are foods with high nutritional quality that possess a unique and delicious flavour that can be marketed at relatively low prices and affordable by the poor (Pingel, 2004). Duck meat is a good source of protein, niacin, phosphorus, riboflavin, iron, zinc, vitamin B-6 and thiamine and smaller amounts of vitamin B-12, folate and magnesium (<http://healthyeating.sfgate.com/duck-meat-cholesterol-2410.html>). Duck eggs are quite large compared to chicken eggs. The large size of the duck egg gives it a larger yoke to white ratio than a chicken egg. Similarly, the protein content is slightly higher in the duck eggs compared to chicken eggs. However, the mineral content of duck eggs is very similar to that of chickens. The eggs of both species contain selenium, manganese, zinc, copper, potassium, sodium, phosphorus, calcium and iron, although the ducks' eggs contain slightly higher amounts of all these minerals. The vitamin content in the duck and chicken is also similar, but duck eggs have a higher amount of each one of the vitamins: thiamin, niacin, riboflavin, pantothenic acid, folate, vitamin B6, vitamin D, vitamin E, vitamin A, vitamin B12 and retinol. Similarly, the amino acid content profile of the egg of both species is similar, but again duck eggs contain more of them: threonine, isoleucine, tryptophan, leucine, methionine, lysine, cystine, tyrosine, phenylalanine, valine, serine, glycine, proline, aspartic acid, histidine, alanine, and arginine (Pinos, 2012).

CONCLUSION AND RECOMMENDATIONS

Much emphasis has been on the use of 'conventional' ASFs (mostly milk, chicken, fish, egg and beef) in SFP in Nigeria. This article has exposed other nutritionally beneficial ASFs referred as the 'lesser utilized' animals (insects, quails, rabbits, snails and ducks) and their products that has been neglected due to restrictions by religion, food taboos, culture, ethnicity personal dislikes and other socio-economic factors. A detailed profiling of these animals ranging from the benefits, simplicity and reduced capital investments involved in rearing them as well as the comparable nutritional qualities with their 'conventional' livestock counterparts has been x-rayed. It has been advocated that ASFs from 'lesser utilized' animals be incorporated as tangible alternatives to boost protein and micronutrients supplies in SFPs in Nigeria. However, to encourage a wide range of acceptance of ASFs the following recommendations are proffered:

- There is need for the creation of more awareness on the nutritional qualities of the meat of ‘lesser utilized’ animals via the media to encourage their utilization in SFPs.
- Training programmes should be organized for youths and adults to gain knowledge on the husbanding methods for these animals in their homes to boost local supplies for SFPs.
- There should be an advocacy on the nullification of taboos, religious, traditional or customary beliefs and personal dislikes to encourage the consumption of these ‘lesser utilized’ animals in communities as animal protein and micronutrient sources in SFPs.
- Attractive processing and preservation methods should be adopted to improve the value of the products. Insects can be processed into pastes or ground into a meal, and their proteins can be extracted and utilized in SFPs.

REFERENCE

- ACC/SCN (2000). Fourth Report on the World Nutrition Situation. ACC/SCN in collaboration with the International Food Policy Research Institute, Geneva, Switzerland.
- Ademolu, K. O., Idowu, A. B., Mafiana, C. F., & Osinowo, O. A. (2004). Performance, proximate and mineral analyses of African giant land snail (*Archachatina marginata*) fed different nitrogen sources. *African Journal of Biotechnology*, 3(8), 412-417.
- Agbidye, F. S., Ofuya, T. I., & Akindele, S. O. (2009). Some Edible insect species consumed by the people of Benue State, Nigeria. *Paskitan Journal of Nutrition*, &(7), 946 – 950.
- Akinnusi, O. (1998). A practical approach to backyard Snail farming. *Nigeria Journal of Animal Production*, 25(2), 193–197.
- Amadi, E. N., Ogbalu, O. K., Barimalaa, I. S., & Pius, M. (2005). Microbiology and nutritional composition of an edible larva (*Bunaea alcinoe* Stoll) of the Niger Delta. *Journal of Food Safety*, 25, 193-197.
- Anca, T., Vacaru-opris, I., & Teusan, V. (2008). Aspects Regarding Some Morphological values of the domestic Quail eggs (*Coturnix coturnix japonica*). *Lucrări stiințifice Zootehnie și Biotehnologie*, 41(2), 709-716.
- Anthony, A. A., Adebayo-Tayo, C. B., Inyang, U. C., Aiyegoro, A. O., & Komolafe, O. A. (2010). Snails as meat source: Epidemiological and nutritional perspectives. *Journal of Microbiology and Antimicrobials*, 2(1), 001-005.
- Assan, N. (2014). Relevance and feasibility of mini livestock farming in enhancing food security in Southern Africa. *Agricultural Advances*, 3(10), 261-267
- Bachan, A. (2016). *A Simple Guide to Duck Raising*. Retrieved on 8th of September, 2016 from: <http://www.turtlevillagetrust.org/pdf/duck.pdf>.
- Bakoji, I., Aliyu, M. K., Haruna, U., Jibril, S. A., Sani, R. M., & Danwnka, H. (2013). Economic Analysis of Quail Bird Production in Bauchi Local Government Area, Bauchi State Nigeria. *Research Journal of Agriculture and Environment Management*, 420-425.
- Banjo, A. D., Lawal, O. A., & Songonuga, E. A. (2006). The nutritional value of fourteen species of edible insects in South-western Nigeria. *African Journal of Biotechnology*, 5(3), 298- 301.
- Braide, W., Sokari, T. G., Hart, A. D., & Nwaoguikpe, R. N. (2010). The nutritional status of seven species of plant leaves as food for an edible larva of a lepidopteran, *Bunaea alcinoe*. *International Journal of Biological Science*, 2(3), 96-102.
- Bukkens, S. G. F. (1997). The nutritional value of edible insects. *Ecology of Food and Nutrition*, 36, 287–319.

- Caulfield, L. E., Richard, S. A., Rivera, J. A., Musgrove, P., & Black, R. E. (2006). Stunting, wasting, and micronutrient deficiency Disorders. In: Jamison, D.T, Breman, J.G, Measham, A.R., Alleyne, G., Claeson, M., Evans, D.B. (eds.), *Disease Control Priorities in developing countries* (2nd ed.). Washington D.C.: World Bank; 2006: 551–68.
- Chege, L. M. (2014). Factors influencing quail farming in Nyeri Central Constituency, Nyeri County, Kenya. Unpublished Master of Arts Degree Thesis, University of Nairobi, Kenya.
- Cobbinah, J. R. (2008). *Snail farming in West Africa: A practical guide*. Agrodok 47. Technical Centre for Agricultural and Rural Cooperation ACP-EU.78pp.
- Collavo, A., Glew, R. H., Huang, Y. S., Chuang, L. T., Bosse, R., & Paoletti, M. G. (2005). House cricket small-scale farming. In M.G. Paoletti (ed.), *Ecological implications of minilivestock: potential of insects, rodents, frogs and snails*. New Hampshire, Science Publishers. pp. 519–544.
- DAFF. (2013). Structure and Dynamic of Quails. *Commonwealth of Australia* , 1-5.
- Dagnelie, P. C., Staveren, W. A., & Hautvast, J. G. (1991). Stunting and Nutrient Deficiencies in children on alternative diets. *Acta Paediatr. Scand.* 372, 111–118.
- Dalle Zotte, A., Ouhayoun, J., Parigi Bini, R., & Xiccato, G. (1996). Effect of age, diet and sex on muscle energy metabolism and on related physicochemical traits in rabbits. *Meat Science*, 43, 15–24.
- Daphna K. D., & Lindsay H. A. (2011). The importance of milk and other animal-source foods for children in low-income countries. *Food and Nutrition Bulletin*, 32(3), 11-21.
- Defoliart, R. G. (1989). The human use of insects as food and as animal feed. *Bulletin of Entomological Society of America*, 35(1), 22-35
- Duck Meat and Cholesterol. Retrieved From: <http://healthyeating.sfgate.com/duck-meat-cholesterol-2410.html>.
- Dufour, D. L. (1987). Insects as Food. A case Study from the Northwest Amazon. *American Anthropol*, 89, 383–397.
- Ebenebe, C. I. (2000). Mini-livestock production in Nigeria. The present and the future. Proceedings of the 5th Annual Conference of Animal Science Association of Nigeria (ASAN), Port Harcourt, Nigeria, Sept., 19-22.
- Ebenso, I. E., (2003). Nutritive potentials of white snails (*Archachatina marginata*) in Nigeria. *Discovery and Innovation*, 15(3/4), 156 – 158.
- Ekop, E.A., Udoh, A. I., & Akpan, P. E. (2010). Proximate and anti-nutrient composition of four edible insects in Akwa Ibom State, Nigeria. *World Journal of Applied Science and Technology*, 2(2), 224–231.
- Elemo, B. O., Elemo, G. N., Makinde, M. A., & Erukainure, O. L. (2011). Chemical evaluation of African palm weevil, *Rhychophorus phoenicis*, larvae as a food source. *Journal of Insect Science*, 11, 146.
- Enser, M., Hallet, K., Hewitt, B., Fursey, G. A. J. & Wood, J. D. (1996). Fatty acid content and composition of English beef, lamb and pork at retail. *Meat Science*, 4, 443–456.
- Falade, O. S., Israel, Oluwemimo, O., Wale, O., & Steve, A. A. (2012). School Feeding Programme in Nigeria: The Nutritional Status of Pupils in a Public Primary School in Ile-Ife, Osun State, Nigeria. *Food and Nutrition Sciences*, 3: 596-605.
- FAO/WHO (1991). Protein Quality Evaluation. *Report of the Joint FAO/WHO Expert Consultation, FAO Food and Nutrition Paper 51*, Bethesda Md. 26-42pp.
- Fasoranti, J. O., & Ajiboye, D. O. (1993). Some edible insects of Kwara State, Nigeria. *American Entomologist*, 39(2), 113 – 116.

- Genchev, A., Mihaylova, G., Ribarski, S., Pavlov, A., & Kabakchiev, M. (2008). Meat Quality and Composition in Japanese Quails. *Trakia Journal of Sciences*, 6(4), 72-82.
- Gardword, V. A., & Diehl, R. C. J. (1987). Body volume and density of live *Coturnix* quail and associated genetic relationships. *Poultry Science*, 66(8), 12-69.
- Gibson, R. S. (1994) Content and bioavailability of trace elements in vegetarian diets. *American Journal of Clinical Nutrition*, 59, 1223S–1232S.
- Hernández, P. (2008). Enhancement of nutritional quality and safety in Rabbit meat. *9th World Rabbit Congress – June 10-13, 2008 – Verona – Italy*.
- Hermida, M., Gonzalez, M., Miranda, M., & Rodriguez-Otero, J. L. (2006). Mineral analysis in Rabbit meat from Galicia (NW Spain). *Meat Science*, 73, 635–639.
- Hu, F. B., & Willett, W. C. (2002). Optimal diets for prevention of coronary heart disease. *Journal of the American Medical Association*, 288, 2569–2578.
- Ifie, I., & Emeruwa, C. H. (2011). Nutritional and anti-nutritional characteristics of the larva of *Oryctes monoceros*. *Agriculture and Biological Journal of North America*, 2(1), 42-46.
- Imevbore, A. (1988). The Nutritive value of African giant land snail *Archachatina marginata*. *Journal of Animal Production and Reservation*, 8(2), 76–87.
- Iraqi, M. M. (2003). Estimation and evaluation of genetic parameters for body weight traits of New Zealand white rabbit in Egypt using different multivariate animal models. *Livestock Research for rural development*. Retrieved from www.Irrd.org/Irr20/5/iraq180083.htm.
- Lalwani P. (2011). Quail Egg Nutrition. Retrieved from <http://www.buzzle.com/articles/quail-egg-nutrition.html>.
- Lebas, F. (1983). Small-scale rabbit production, feeding and management system. *World Animal Review*, 46, 11-17.
- Mamattah, N. (1978). Sociological aspects of introducing rabbits into farm practices. In: Proc. Workshop on Rabbit Husbandry in Africa, Morogoro, Tanzania, Stockholm, Sweden. IFS, pp. 93-99.
- Martens, T. (2007). Impact of the Ghana School Feeding Programme in 4 districts in Central Region, Ghana. MSc Thesis, Wageningen University, Wageningen, UR.
- McNeill, S. (2007). Foods from animal sources provide key micronutrients. *Diet/Health/Nutrition*. Issue Update: 16 -17.
- MOLD. (2012). *A Guide to Quail Farming*. Ministry of Livestock Development: Nairobi.
- Mosie, E. (2004). The Nutritional Quality Of Feeding Programs In Botswana Junior Secondary Schools and the contribution of Family and consumer sciences/ Home Economics Teachers to Meal Quality. PhD Thesis in Family and Consumer Sciences Education, Texas Technical University.
- Myers, G. S. (2016). Alternative Livestock Overview- Raising and Marketing Exotic, Non-Conventional, Heritage or Rare Breed Animals. Retrieved from <https://extension.umd.edu/sites/default/files/docs/Alternative%20Livestock.pdf>.
- Nakagaki, B. J., & DeFoliart, G. R. (1991). Comparison of diets for mass-rearing *Acheta domesticus* (Orthoptera: Gryllidae) as a novelty food, and comparison of food conversion efficiency with values reported for livestock. *Journal of Economic Entomology*, 84(3), 891–896.
- Neumann, C. G., Bwibo, N. O., Murphy, S. P., Sigman, M., Whaley, S., Allen, L.H., Guthrie, D., Weiss, R. E., & Demment, M. W. (2003). Animal Source Foods Improve Dietary Quality, Micronutrient Status, Growth and Cognitive Function in Kenyan School Children: Background, Study Design and Baseline Findings. *Journal of Nutrition*, 133, 3941S – 3949S.

- Nkouka, E. (1987). Les insectes comestibles dans les sociétés d'Afrique Centrale. *Revue Scientifique et Culturelle du CICIBAASC LEIDEN*, 6(1), 171–178.
- NRC. (1991). *Micro Livestock: Little Known Small Animals with a Promising Economic Future*. National Academy Press: Washington DC.
- Onyewuchi, U. U., Offor, I. R. and Okoli, C. F. (2013). Profitability of Quail birds and Egg Production in Imo State. *Nigerian Journal of Agriculture, Food and Environment*, 40-44.
- Olusanya, J. O. (2010). Assessment of the Food Habits and School Feeding Programme of Pupils in a Rural Community in Odogbolu Local Government Area of Ogun State, Nigeria. *Pakistan Journal of Nutrition*, 9(2), 198-204.
- Otieno, D. (2014). Influence of School Feeding Program on Academic Performance of Pre-School Children in Kayole Zone, Nairobi County. B.Ed Dissertation in Early Childhood Education, Department of Education, Communication and Technology University of Nairobi.
- Paiko, Y. B., Dauda, B. E. N., Salau, R. B., & Jacob, J. O. (2012). Preliminary data on the nutritional potentials of the larvae of edible dung beetle consumed in Paikoro Local Government Area of Niger State, Nigeria. *Continental Journal of Food Science and Technology*, 6 (2), 38–42.
- Pimentel, D., & Pimentel, M. (2003). Sustainability of meat-based and plant-based diets and the environment. *American Journal of Clinical Nutrition*, 78, 660S–663S.
- Pingel, H. (2004). Duck and geese production. *World Poultry*, 20(8), 16 – 26.
- Pinos, T. (2012). Duck eggs vs Chicken eggs. Retrieved from http://www.localharvest.org/blog/16682/entry/duck_eggs_vs_chicken_eggs.
- Raven, T. C. (1960). *Raven's Progressive Matrices*. In: *Guide to Standard Progressive Matrices*. New York, NY: Psychological Corporation.
- Ruiz-Feria, C. A., Lukefahr, S. D., & Felker, P. (1998). Evaluation of *Leucaena leucocephala* and Cactus (*Opuntia sp*) as forages for growing rabbits. Livestock research for rural development. <http://www.cipav.org.co/lrrd10/2/luke102.htm>. Accessed on the 12th of August, 2016.
- Santos Oliveira, J. F., Passos de Carvalho, J., Bruno de Sousa, R. F. X., & Madalena Simao, M. (1976). The nutritional value of four species of insects consumed in Angola. *Ecology of Food and Nutrition*, 5, 91–97.
- Schlolaut, W. (1985). Nutritional Needs and Feed of German Angora Rabbits. *Journal of Applied Rabbit Research*, 10, 111–121.
- Schonfeldt, H. C. (2013). Fish, chicken, lean meat and eggs can be eaten daily: a food-based dietary guideline for South Africa. *South African Journal of Clinical Nutrition*, 26(3), 66–76.
- Scrimshaw, N. (1994). The consequences of hidden hunger for individuals and societies. *Food Nutrition Bulletin*, 15, 2–23.
- Shanaway, M. M. (2008). Quail production systems: A review. FAO: Rome.
- Shalene McNeill (2007). Foods from animal sources provide key micronutrients. Issue update Diet/Health/Nutrition, 16-17.
- Simonova, M. P., Chrastinova L., Mojto, J., Laukova, A., Szabova, R., & Rafay, J. (2010). Quality of Rabbit meat and phyto-additives. *Czech Journal of Food Science*, 28, 161–167.
- Shanaway, M. M. (2008). *Quail production systems: A review*. Rome: FAO.
- Smil, V. (2002). Worldwide transformation of diets, burdens of meat production and opportunities for novel food proteins. *Enzyme and Microbial Technology*, 30, 305–311.

- Solomon, M., & Prisca, N. (2012). Nutritive value of *Lepidoptara litoralia* (edible caterpillar) found in Jos Nigeria: Implication for food security and poverty alleviation. *African Journal of Food Agriculture and Nutrition. Development*, 12(6), 6737-6747.
- Sonale, O. V. Chappalwar, A. M., & Devangare, A. A. (2014). Effect of frozen storage on the physico-chemical quality and histology of Quail breast meat. *Indian Journal of Veterinary and Animal Science Research*, 43(6), 426–435.
- Thomas, K. S., Jagatheesan, P. N. R., Lurthu Reetha, T., & Rajendran, D. (2016). Nutrient composition of Japanese quail eggs. *International Journal of Science, Environment and Technology*, 5(3), 1293–1295.
- Townsend E. C. (1985). *Nutrition and Diet Therapy*. 4th Edition. New York, N.Y: Delmar Publishers.
- Tunsaringkarn, T., Tungjaroenchai, W and Siritwong, W. (2013). Nutrient Benefits of Quail (*Coturnix coturnix japonica*) Eggs. *International Journal of Scientific and Research Publication*, 3(5), 1–8.
- USDA (2006). National Nutrient Standard Reference. *Release 19*.
- van der Meulen, S. J., & den Dikken, G. (2004). Duck keeping in the tropics. *Agrodok 33*. Agromisa Foundation, Wageningen.
- van Huis, A. (2013). Potential of insects as food and feed in assuring food security. *Annual Review of Entomology*, 58(1), 563–583.
- Veldkamp, T., G. van Duinkerken, A., van Huis, C. M. M., Lakemond, E., Ottevanger, E., & van Boekel, M. A. J. S. (2012). *Insects as a sustainable feed ingredient in pig and poultry diets. A feasibility study*. Wageningen UR Livestock Research, Report 638.
- WFP (2009). World Food Programme: School Feeding Reduces Hunger and Improves Education. retrieved from <http://www.wfp.org/school>.
- Wilkinson, J. (1999). Physical Healing Atonement and the Body in the Old Testament. *Evangelical Quarterly*, 195-208.
- World Health Organization, (2009). Global prevalence of vitamin A deficiency (1995–2005). Geneva.
- Yalcin, S., Oúuz, F., & Yalcin, S (2005). Effect of Dietary Hazelnut Meal Supplementation on the Meat Composition of Quails. *Turkey Journal of Veterinary and Animal Science*, 29, 1285 –1290.