Technical Brief #1:

*Ruspolia* grasshopper production systems in East Africa and their nutritional properties

Authors:
- John Kinyuru
- Jozef Vanden Broeck
- Monicah Ayieko
- Forkwa Fombong
- Jeremiah Ng’ang’a

December 2018
Introduction
The consumption of the naturally occurring longhorn grasshopper, *Ruspolia differens* locally known as *senene*, is an important part of food culture in several regions of East-Africa and contributes significant protein intake of the rural and urban population. For many households, trade in edible insects is a major source of income and considerably contributes to improvements in livelihood (Agea, Biryomumaisho, Buyinza, & Nabanoga, 2008). Grasshoppers have traditionally been harvested seasonally from the wild. This method of collection can be unsustainable for the wider ecosystem due to overharvesting or destructive techniques. One of the main benefits of utilizing insects as part of the human diet has been their beneficial nutritional profile, comparable to conventional meats such as chicken and beef (Rumpold & Schlüter, 2013).

Although farming technologies for other insects like the cricket (Orthoptera; Gryllidae) are fairly advanced in Asia (e.g. Thailand, Laos) and East Africa, equivalent knowledge for its grasshopper is lacking, especially given the popularity of its consumption. In the case of grasshoppers, preliminary studies performed in Uganda have shown that *R. differens* can be produced under small-scale laboratory conditions but several aspects of its biology need to be evaluated to optimize production techniques.

This brief provides an overview of harvesting and rearing systems for the *Ruspolia* grasshopper. It provides an outline of wild harvesting, rearing facilities and management practices, as well as how to rear insects under the prevailing local conditions. It further summarizes the nutritional properties of wild harvested grasshoppers in East Africa region.

Occurrence, collection and harvesting
Swarming behaviour in *Ruspolia* spp. has been a seasonal occurrence in Kenya, Uganda and Tanzania. Swarms are observed in the months of March and October during the rainy seasons (Kinyuru, Kenji, & Njoroge, 2009). The grasshoppers swarm from the wild and can be collected in the early morning. Some authors have reported that they perch on trees, shrubs and houses during swarming. Swarming in diverse localities has revealed their ability to feed on a wide range of diets and live together in high densities, suggesting that their rearing would be economically feasible.
Colour polymorphism has been reported with green, brown and purple color variations described (Mmari, Kinyuru, Laswai, & Okoth, 2017). Currently, *Ruspolia* are harvested in the wild in a non-sustainable and destructive manner (Mmari et al., 2017), and there is little if any knowledge in East Africa on optimizing harvesting practices to sustain the wild insect populations.

**Processing and consumption**

After harvesting, the grasshoppers are transported to the market where they are de-winged and their legs detached. The grasshoppers are processed before consumption. Cases of raw consumption have not been reported.
Traditional processing methods are mostly similar among insect-consuming societies in Africa with slight differences between the processes. Processing is normally done for value addition to increase palatability, safety and for preservation purpose. Cleaning is done to remove inedible body parts namely wings, appendages and ovipositor. Wood ashes are used to increase friction and ease the process. Sometimes, washing with cold water before further processing is done. Boiling, smoking, salting, toasting, deep frying, sun drying are some of the methods used to process grasshoppers (Mmari et al., 2017). They are then consumed either as a snack or as a side dish with stiff porridge (ugali)(Ayieko et al., 2015). Modern processing methods have also been evaluated in order to improve shelf life. Oven drying, freeze drying, microwaving are some of the methods currently being evaluated.

**Under-nutrition and what grasshoppers can contribute**

Around 30 % of households in Kenya are still food insecure, especially in rural areas. Children are most affected in their first five years, by lacking important macro and micro nutrients for their development. The prevalence of approximately 35% of children less than five years being stunted with 4% severely underweight and 6% are wasted (KDHS, 2014). One way to prevent and treat under-nutrition and micronutrient deficiency is diversifying on diets to include more nutritious foodstuff.
Insects are a source of both macro and micro nutrients. The protein quality is high, equal to other animal food such as meat (Fombong, Van Der Borght, & Broeck, 2017; Rumpold & Schlüter, 2013). Edible insects therefore have a potential to improve the diets and reduce under-nutrition.

The exoskeleton of insects contains chitin, the nutritional contribution and potential health impact of chitin is uncertain. Chitin has however been associated with health benefits in some population groups (e.g. in risk of obesity). Insect chitin can also have prebiotic effects to stimulate growth of *bifido bacteria* and *lactobacilli* (Kipkoech et al (unpublished). The following table shows some nutritional profile of *Ruspolia* in East Africa

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Green, Fresh (Kinyuru et al., 2009)</th>
<th>Brown dried (Kinyuru et al., 2009)</th>
<th>Oven dried (Fombong et al., 2017)</th>
<th>Freeze dried (Fombong et al., 2017)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Macronutrients (g/100g)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td>43</td>
<td>44</td>
<td>48</td>
<td>51</td>
</tr>
<tr>
<td>Fat</td>
<td>48</td>
<td>46</td>
<td>35</td>
<td>46</td>
</tr>
<tr>
<td>Ash</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Fibre</td>
<td>4</td>
<td>5</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Energy (Kcal/Kg)</td>
<td>-</td>
<td>-</td>
<td>524</td>
<td>519</td>
</tr>
<tr>
<td><strong>Micronutrients (mg/100g)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>27</td>
<td>24</td>
<td>896</td>
<td>1035</td>
</tr>
<tr>
<td>Magnesium</td>
<td>34</td>
<td>33</td>
<td>146</td>
<td>161</td>
</tr>
<tr>
<td>Potassium</td>
<td>371</td>
<td>260</td>
<td>779</td>
<td>816</td>
</tr>
<tr>
<td>Iron</td>
<td>17</td>
<td>13</td>
<td>216</td>
<td>220</td>
</tr>
<tr>
<td>Zinc</td>
<td>17</td>
<td>12</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td><strong>Fatty Acids (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SFA</td>
<td>38</td>
<td>39</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>MUFA</td>
<td>27</td>
<td>26</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>PUFA</td>
<td>34</td>
<td>34</td>
<td>17</td>
<td>16</td>
</tr>
</tbody>
</table>
Ruspolia farming systems

Cage system

Various research projects are evaluating farming viability of *Ruspolia* species in the Lake Region of East Africa. Adult *Ruspolia* weighs 0.4 – 0.6g. The life cycle of *Ruspolia* is between 12-15 weeks. *Ruspolia* is resilient to changes of conditions in rearing environment and is nocturnal, eating mostly at night. Recent studies are showing that *Ruspolia* like eating other insects partly explaining the presence of the narrow bee fly amongst the *Ruspolia* swarms in the wild (Mmari et al., 2017). Studies are still on-going to optimize and standardize raring conditions.

Container system

*Ruspolia* can be reared in containers of various types such as glass cages, wooden boxes, concrete blocks or cylinders, and plastic drawers or crates. The size and number of such containers depends on the availability of space as well as the scale of production. In all systems hideouts and patching areas must be provided. Hideout areas are necessary to minimize cannibalism. It’s
important to protect the *Ruspolia* from predators using netting or wire gauze. Predators include lizards, rats, spiders, snakes etc.

*Ruspolia* lay eggs within grass stalks. It’s therefore important to provide green grass (e.g. maize stems) in the rearing cage or container. However, studies have shown that *Ruspolia* can lay in other media including sand and cotton wool. Studies have identified optimal condition of incubating *Ruspolia* eggs to be 30°C and 70% relative humidity.

**Picture 9:** *Ruspolia* eggs on a grass stalk. Source: Jeremiah Ng’ang’a

**Picture 10:** *Ruspolia* eggs on cotton wool. Source: Jeremiah Ng’ang’a

*Ruspolia* feed and formulations
Feed is a significant challenge in livestock systems around the world. Providing affordable, nutritious and safe feed to *Ruspolia* is an ongoing area of research in East Africa (Malinga et al., 2018a, 2018b). The optimal composition of feed depends on the growth stage of the *Ruspolia* and locally available sources of feed. Feeding trials for the *Ruspolia* project are being carried out under laboratorial conditions at ICIPE and under commercial conditions at JKUAT and JOOUST in order to identify and optimize *Ruspolia* feeds based on local substrates.

Feed substrates being evaluated at farm level include conventionally compounded meals made from seasonally available cereals and legumes like maize, sorghum and soybeans, and indigenous grasses. Animal proteins in the meals are sourced from *omena* fish, black soldier fly and fruits fly larvae. On-going studies reveal that *Ruspolia* are carnivorous and like hunting other insects especially at night. Farmers also use forage leaves to substitute vegetables during the dry season.
Way forward

The final results of the *Ruspolia* project should provide small scale farmers with options for an optimized wild harvesting techniques, efficient and cost-effective feed regime as well as caging systems that are adaptable by using only locally available materials that are cost-effective. *Ruspolia* farming can be embraced as a mini-livestock by farmers in varied agro-ecological conditions in the Lake Region in East Africa.

While *Ruspolia* farming can help rural communities in the region to build more sustainable livelihoods, it is important to note that issues such as appropriate and affordable feed and rearing systems and their cost implications can prevent households from entering into production. The development of feeds that meet the *Ruspolia* nutritional requirements using locally available feedstuffs will be valuable for farmers and ultimately a significant determining factor in the acceptance of this livelihood strategy.

Based on this study, we can so far conclude that;

- The cage system has potential for optimal commercial production, however, their suitability for different agro ecological conditions needs to be investigated.
- *Ruspolia* farming can be knowledge intensive, especially concerning *Ruspolia* feed management. In order to obtain optimal production, training of farmers is required on the importance of nutritious and safe feed composition.
- Farmers are still hesitant to enter into *Ruspolia* farming due to a lack of capacity on farming skills.
- Further outreach to rural farmers is needed in order to inform and develop interest in this livelihood strategy. This must go hand in hand with the development of domestic markets, an issue that will be the centre of the next information brief
This brief was issued by the Ruspolia project (ZEIN2016PR426) (Using the edible insect - Ruspolia differens to enhance food security in East Africa) supported by Flemish Interuniversity Council (VLIR-UOS), The brief was written by Dr. John Kinyuru (JKUAT, Kenya), Prof. Monica Ayieko (JOOST, Kenya), Prof. Jozef Vanden Broeck (KU Leuven, Belgium), Forkwa Fombong (KU Leuven, Belgium), and Jeremiah Ng’ang’a (JKUAT, Kenya).

For further questions, please contact:
Flemish Promoter: Prof. Jozef Vanden Broeck (jozef.vandenbroeck@bio.kuleuven.be)
Local Promoter (Kenya): Dr. John Kinyuru (jkinyuru@agr.jkuat.ac.ke)

Bibliography


